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**COMPENDIUM OF SPEECH TESTING MATERIAL
AND TYPICAL NOISE SPECTRA FOR USE IN
EVALUATING COMMUNICATIONS EQUIPMENT**

J. C. Webster

Naval Electronics Laboratory Center
San Diego, California

13 September 1972

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SPEECH TESTING MATERIAL
AND
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**Explanatory material, lists, and answer sheets allow
selection of tests appropriate to needs**

J. C. Webster

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INTRODUCTION

At least once a year over the past 25 years the Psychoacoustics Branch of the Human Factors Technology Division has been asked for a good (appropriate, meaningful, expeditious, scientific, quantitative) speech (word, sentence, navy phrase) test for evaluating (proving, condemning, whitewashing) a speech communication system (component, equipment, circuit). There are, in fact, at least 10 standardized tests that can, when properly chosen, give reliable (repeatable) scores varying from 50% to 95% on the same "test system." This apparent anomaly exists not because speech scientists do not know their business but because of the extreme redundancy of spoken language. There are many facets of language and test design that must be understood, controlled, and specified before any quantitative score (percentage of words or sentences correct) really has any meaning. Since this document is not meant to be a comprehensive treatise on the subject but more of a handbook or guide, these points are mentioned only in the briefest form. Reference is made to published papers and books for more details.

Actual lists and answer sheets are included so that anyone can choose a test ONCE HE UNDERSTANDS WHICH TEST IS APPROPRIATE FOR HIS NEEDS.

LANGUAGE FACTORS AFFECTING INTELLIGIBILITY

VOCABULARY SIZE AND PHONETICALLY BALANCED WORD TESTS

The potential size of the word lists from which either the talker or the listener makes his selection affects the intelligibility score. If both talker and listener know that only two words will be transmitted — say, "yes" and "no" — a score of 50% will result from chance alone and scores near 100% can well be expected. If only the digits zero through nine(r) are transmitted, chance scores of 10% will occur and scores above 90% can be expected.

The oldest and most respected of commonly used word tests was compiled by Egan (1948) during World War II. Egan compiled 1000 mono-syllabic words, then arranged them in 20 lists of 50 words so that each list was "phonetically balanced." That is, within each list the phonetic balance of the English language as a whole was accurately represented. These phonetically balanced (PB) words are listed in exhibit 1. Each word is followed by a numeral from 1 to 20 specifying the list it is to be used in.

To give the test, separate the words into the 20 lists and randomize the word order (do not read them alphabetically). The listener copies on plain paper what he hears. Spelling is NOT crucial — "aisle" equals "isle."

Caution. These tests are difficult to administer, score, and interpret. Talker and listening crews must be trained for weeks. A gap of 4 seconds must be allowed between words (to give listener time to write). The talkers must use a carrier phrase such as, "Number one, you will write the word _____ now." In tightly controlled tests, the talker should monitor each transmission to get the same voice level or intensity (reading on a VU, or equivalent, meter) on the word "word." Assuming the talker/listener crews

EXHIBIT 1: EGAN'S 1000 PHONETICALLY BALANCED MONOSYLLABIC WORDS.

1. ACE	20	51. BECK	5	.01. CAMP	10	151. CLOG	20	201. DAB	2
2. ACHE	3	52. BEE	4	102. CARE	1	152. CLOSED	16	202. EAD	6
3. ACT	7	53. BEEF	9	103. CANT	19	153. CLOTH	6	203. DAME	16
4. ADD	5	54. BELL	15	104. CAPE	3	154. CLOTHES	10	204. DART	14
5. AGE	19	55. BEST	6	105. CAR	14	155. CLOUD	6	205. DART	17
6. AID	16	56. BET	7	106. CART	20	156. CLOVE	2	206. DASH	14
7. AIL	10	57. BID	8	107. CARVE	9	157. CLOWN	1	207. DAUB	10
8. AIM	7	58. BIG	17	108. CASE	17	158. CLUB	9	208. DAY	8
9. AIMS	18	59. BIND	8	109. CAST	3	159. CLUE	17	209. DEAD	14
10. AIR	3	60. BIRTH	9	110. CAT	18	160. CODE	11	210. DEAF	13
11. ALL	17	61. BIT	9	111. CATCH	8	161. CLUTCH	12	211. DEATH	1
12. AM	7	62. BLACK	5	112. CAVE	12	162. COAST	7	212. DEBT	18
13. AND	12	63. BLESS	18	113. CHAFE	12	163. COAX	14	213. DECK	3
14. APT	17	64. BLIND	15	114. CHAFF	18	164. COB	6	214. DEED	1
15. ARC	11	65. BLISS	11	115. CHAIN	18	165. COD	8	215. DEEP	6
16. ARCH	9	66. BLONDE	4	116. CHAIR	12	166. CODE	11	216. DEPTH	12
17. ARE	1	67. BLUFF	12	117. CHAMP	10	167. COMES	7	217. DEUCE	8
18. ARM	11	68. BLUSH	2	118. CHANCE	10	168. COOK	7	218. DICE	18
19. ART	18	69. BOB	10	119. CHANGE	13	169. CORD	10	219. DID	20
20. AS	6	70. BOG	6	120. CHANT	8	170. CORK	20	220. DIG	3
21. ASK	8	71. BOLT	8	121. CHAP	12	171. CORN	13	221. DIKE	1
22. ASS	12	72. BOOK	16	122. CHARGE	2	172. CORPSE	2	222. DILL	3
23. AT	14	73. BOOST	9	123. CHART	6	173. COST	15	223. DIME	12
24. AWE	2	74. BOOTH	17	124. CHAT	19	174. COURSE	4	224. DIN	16
25. AXE	18	75. BORED	8	125. CHEAP	15	175. COURT	4	225. DINE	17
26. BACK	10	76. BOSS	15	126. CHEAT	5	176. COW	10	226. DIP	11
27. BAD	1	77. BOUGH	19	127. CHECK	3	177. CRAB	18	227. DISH	1
28. BADGE	6	78. BOUGHT	2	128. CHEESE	16	178. CRACK	8	228. DITCH	9
29. BAIT	2	79. BOUNCE	2	129. CHESS	9	179. CRAS.;	1	229. DIVE	15
30. BALD	3	80. BOX	1	130. CHEST	9	180. CRATE	20	230. DODGE	4
31. BAILE	18	81. BRACE	17	131. CHEW	8	181. CRAVE	3	231. DOG	13
32. BALL	12	82. BRAID	17	132. CHILL	18	182. CREED	1	232. DONE	12
33. BAR	1	83. BRASS	20	133. CHINK	12	183. CREWS	16	233. DOPE	7
34. BARB	3	84. BRONZE	5	134. CHIP	18	184. CRIB	6	234. DOSE	7
35. BARGE	16	85. BROWSE	5	135. CHOOSE	5	185. CRIME	3	235. DOT	18
36. BARK	19	86. BUCK	17	136. CHOP	7	186. CROWD	9	236. DOUBT	11
37. BARN	14	87. BUD	2	137. CHOSE(CHÖZ)	19	187. CRUDE	19	237. DOUGH	19
38. BASE	20	88. BUDGE	4	138. CHUNK	11	188. CRUSH	17	238. DOUSE	14
39. BASH	10	89. BUG	10	139. CLASH	11	189. CRUTCH	11	239. DOVE(DUV)	15
40. PASK	1	90. BUS	4	140. CLASS	3	190. CRY	11	240. DRAPE	16
41. BAT	13	91. BUSH	4	141. CLAW	18	191. CUB	18	241. DRAKE	11
42. BATH	4	92. BUST	14	142. CLAWS	18	192. CUD	9	242. DROOP	16
43. BATHE	5	93. BUT	7	143. CLEANSE	1	193. CUE	10	243. DROP	3
44. BAY	19	94. BUZZ	19	144. CLICK	20	194. CUFF	15	244. DRUG	19
45. BEAD	3	95. BY	7	145. CLIFF	16	195. CUP	19	245. DUB	16
46. BEAM	11	96. CAB	19	146. CLIMB	13	196. CURB	13	246. DUKE	20
47. BEAN	2	97. CAD	12	147. CLIMB	12	197. CURSE	5	247. DULL	11
48. BEARD	20	98. CAGE	19	148. CLIP	14	198. CURVE	14	248. DUMB	8
49. BEAST	4	99. CALF	8	149. CLOAK	4	199. CUT	7	249. DUNE	19
50. BEAU	13	100. CALVE	19	150. CLOP	8	200. CUTE	14	250. DUNG	14

EXHIBIT 1 (Continued).

251.	DUPE	4	301.	FIT	17	351.	FUSE	9	401.	HAT	10	451.	ITCH	9
252.	IWARF	7	302.	FIVE	2	352.	FUSS	1	402.	HATCH	4	452.	JAB	11
253.	EACH	8	303.	FLAG	9	353.	GAB	16	403.	HATE	13	453.	JADE	15
254.	EARL	2	304.	FLAME	15	354.	GAGE	6	404.	HAVE	11	454.	JAG	6
255.	EARN	4	305.	FLANK	19	355.	GANG	20	405.	HEAP	1	455.	JAM	3
256.	EARS	10	306.	FLAP	5	356.	GAP	6	406.	HEAD	12	456.	JAUNT	11
257.	EARTH	10	307.	FLARE	18	357.	GAPE	5	407.	HEAT	14	457.	JAW	12
258.	EASE	8	308.	FLASH	20	358.	GAS	16	408.	HEDGE	15	458.	JAY	10
259.	EAT	6	309.	FLAUNT	10	359.	GASH	15	409.	HEED	4	459.	JAZZ	12
260.	EBB	19	310.	FLEET	15	360.	GASP	7	410.	HENCE	17	460.	JELL	8
261.	EDGE	15	311.	FLICK	6	361.	GATE	9	411.	HID	1	461.	JIG	13
262.	EEL	4	312.	FLIGHT	10	362.	GEM	13	412.	HIDE	18	462.	JOB	2
263.	ELF	15	313.	FLING	7	363.	GET	20	413.	HIGH	5	463.	JOKE	20
264.	ELK	13	314.	FLIP	8	364.	GILL	2	414.	HIKE	19	464.	JOLT	12
265.	ELM	13	315.	FLOAT	4	365.	GIN	19	415.	HILL	5	465.	JUDGE	20
266.	ELSE	2	316.	FLOG	12	366.	GIVE	9	416.	HIM	7	466.	JUG	7
267.	END	1	317.	FLOOD	12	367.	GLOSS	2	417.	HIRE	2	467.	KEFT	6
268.	ETCH	10	318.	FLOP	6	368.	GLOVE	15	418.	HIS	18	468.	KEY	9
269.	ZYE	20	319.	FLUFF	9	369.	GNASH	12	419.	HISS	4	469.	KICK	14
270.	EYES	6	320.	FLUSH	3	370.	GNAW	3	420.	HIT	2	470.	KID	5
271.	FACT	15	321.	FOAM	14	371.	GOAT	11	421.	HITCH	6	471.	KILL	8
272.	FAD	8	322.	FOE	9	372.	GOR	20	422.	HIVE	1	472.	KIND	16
273.	FADE	18	323.	FOLD	13	373.	GOD	19	423.	HOCK	2	473.	KISS	15
274.	FAIR	20	324.	FOLK	1	374.	GOLF	15	424.	HOG	11	474.	KIT	11
275.	FAKE	7	325.	FOND	19	375.	GOOD	5	425.	HOLE	15	475.	KITE	4
276.	FALL	6	326.	FOOD	8	376.	GOOSE	10	426.	HOOD	17	476.	KNEE	16
277.	FALLS	17	327.	FOOL	18	377.	GOT	18	427.	HOOF	9	477.	KNIFE	12
278.	FAME	3	328.	FOOT	12	378.	GRAB	18	428.	HOOK	13	478.	KNIT	7
279.	FAN	19	329.	FOR	13	379.	GRACE	9	429.	HOSE	16	479.	LAD	19
280.	FAR	3	330.	FORCE	10	380.	GRADE	7	430.	HOT	4	480.	LAG	11
281.	FAST	20	331.	FORD	1	381.	GRAPE	13	431.	HOW	4	481.	LAP	10
282.	FAT	18	332.	FORGE	6	382.	GRATE	14	432.	HOWL	14	482.	LASH	12
283.	FATE	2	333.	FORM	17	383.	GRAVE	13	433.	HUG	12	483.	LAST	17
284.	FEAST	1	334.	FORT	7	384.	CRAY	18	434.	HULL	6	484.	LATCH	11
285.	FED	12	335.	FORTH	8	385.	GREEK	5	435.	HUM	8	485.	LATHE	14
286.	PEE	6	336.	FOUGHT	12	386.	GREET	12	436.	HUMP	20	486.	LAUGH	12
287.	FEED	5	337.	FOWL	6	387.	GREW	18	437.	HUNCH	12	487.	LAW	3
288.	FEEL	11	338.	FRAUD	1	388.	GROPE	6	438.	HUNK	14	488.	LAY	16
289.	FEET	17	339.	FREAK	8	389.	GROUP	14	439.	HUNT	1	489.	LEASH	16
290.	FELL	17	340.	FREEZE	18	390.	GROVE	1	440.	HURL	3	490.	LEAVE	3
291.	FERN	1	341.	FRESH	17	391.	GRUDGE	5	441.	HURT	10	491.	LED	19
292.	FEW	13	342.	FRIGHT	16	392.	GUESS	8	442.	HUSH	18	492.	LEDGE	12
293.	FIFE	14	343.	FRILL	12	393.	GULL	10	443.	HUT	19	493.	LEFT	8
294.	FIFTH	16	344.	FRISK	11	394.	GUM	17	444.	ICE	9	494.	LEG	6
295.	FIG	3	345.	FROCK	8	395.	GUN	7	445.	IF	17	495.	LEND	5
296.	FILL	13	346.	FROG	2	396.	GUSH	18	446.	IN	20	496.	LESS	15
297.	FIN	4	347.	FRONT	8	397.	CYP	19	447.	INCH	5	497.	lick	8
298.	FIND	19	348.	FROWN	4	398.	HACK	13	448.	INK	16	498.	LID	20
299.	FINE	11	349.	FUDGE	11	399.	HAD	16	449.	IS	1	499.	LIFE	14
300.	FIR	10	350.	FUME	9	400.	HASH	16	450.	ISLE	14	500.	LIME	18

EXHIBIT 1 (Continued).

501. LINE	10	551. NAB	2	601. PACK	20	651. PROBE	11	701. RICE	11
502. LIP	18	552. NAG	13	602. PACT	9	652. PRUD	11	702. RICH	7
503. LIT	9	553. NAP	16	603. PAD	20	653. PRUDE	14	703. RID	14
504. LOG	2	554. NAUGHT	15	604. PAGE	10	654. PUFF	5	704. RIDE	1
505. LOOK	8	555. NEAT	4	605. PAID	17	655. PUG	13	705. RIDGE	17
506. LOOSE	12	556. NECK	3	606. PAN	1	656. PULSE	3	706. RIND(RIND)	5
507. LOSE(LOO2)	19	557. NEED	2	607. PANTS	1	657. PUMP	16	707. RIP	10
508. LOSS	11	558. NERVE	9	608. PARE	17	658. PUNK	6	708. RIPE	12
509. LOUD	18	559. NEST	3	609. PARK	12	659. PUNT	5	709. RISE	1
510. LOUSE	16	560. NET	11	610. PART	16	660. PURGE	14	710. RISK	11
511. LOVE	5	561. NEW	4	611. PASS	5	661. PUFI	15	711. ROAM	17
512. LOW	11	562. NEWS	14	612. PAST	17	662. PURSE	11	712. ROAR	7
513. LUNGE	18	563. NEXT	16	613. PASTE	19	663. PURSE	11	713. ROB	18
514. LUSH	3	564. NICE	13	614. PATCH	13	664. PUS	6	714. ROBE	20
515. LUST	19	565. NICK	14	615. PATH	3	665. PUSS	20	715. ROCK	16
516. LYNCH	18	566. NIFCE	2	616. PEAFL	17	666. PUT	10	716. ROD	8
517. MA	17	567. NICH	6	617. PECK	4	667. QUACK	14	717. RODE	5
518. MADE	13	568. NIGHT	8	618. PEY	17	668. QUART	2	718. ROE	5
519. MANCE	1	569. NINE	7	619. PFLT	13	669. QUEEN	8	719. ROGUE	16
520. MAP	16	570. NINTH	15	620. PENT	7	670. QUICK	15	720. ROLL	8
521. MASH	6	571. NIP	13	621. JERCH	19	671. QUIP	20	721. ROMP	12
522. MASS	9	572. NO	1	622. PERK	2	672. QUIZ	7	722. ROOMS	6
523. MAST	5	573. NOD	14	623. PERT	4	673. RACE	4	723. ROOST	20
524. MAY	15	574. NOOK	1	624. PEST	1	674. RACK	4	724. ROOT	9
525. MAZE	10	575. NOOSE	9	625. PEW	20	675. RAFT	19	725. ROPE	8
526. ME	14	576. NOSE	5	626. PHASE	7	676. RAG	1	726. ROSE	18
527. MERGE	4	577. NOT	1	627. PHONE	9	677. RAGE	17	727. ROT	8
528. MESH	15	578. NOTCH	19	628. PICK	2	678. RAID	7	728. ROTE	19
529. MIST	17	579. NOTE	18	629. PIG	7	679. RAISE	6	729. ROUGE	20
530. MITT	15	580. NUDGE	10	630. PILE	1	680. RAMP	20	730. ROUGH	6
531. MODE	15	581. NUT	2	631. PINCH	4	681. RANGE	7	731. ROUSE	3
532. MOOD	13	582. NUTS	9	632. PINK	10	682. RAP	2	732. ROUT(ROWT)	20
533. MOOSE	2	583. OAK	3	633. PINT	8	683. RAPE	10	733. ROVE	12
534. MOP	13	584. OATH	15	634. PIPE	5	684. RASH	7	734. RUB	1
535. MOPE	10	585. ODD	9	635. PIT	2	685. RAT	1	735. RUDE	9
536. MORI	15	586. ODDS	5	636. PITCH	16	686. RATE	3	736. RUG	16
537. MOF I	11	587. ODE	6	637. PLEAD	13	687. RAVE	4	737. RULE	19
538. MCIE	7	588. OFF	7	638. PLEASE	3	688. RAW	4	738. RUSH	10
539. MOTH	13	589. OFT	14	639. PLOD	7	689. RAY	6	739. RUT	4
540. MOUTH	11	590. OILS	4	640. PLOW	17	690. REACH	17	740. RYE	16
541. MOVE	4	591. ON	19	641. PLUS	10	691. REAL	10	741. SACK	18
542. MOW(MO)	20	592. OR	4	642. PLUSH	1	692. REAP	6	742. SAG	7
543. MUCK	3	593. OUCH	18	643. POD	4	693. REAR	5	743. SAGE	4
544. MUD	7	594. OUGHT	13	644. POND	11	694. REED	9	744. SALVE	20
545. MUFT	13	595. OUR	2	645. POUNCE	7	695. REEF	11	745. SANG	16
546. MUSH	13	596. OUT	12	646. PRESS	17	696. REEK	12	746. SAP	11
547. MESS	14	597. OWE	13	647. PRICE	13	697. REST	8	747. SASH	18
548. MUTE	2	598. OWLS	5	648. PRIEST	12	698. RETCH	20	748. SAT	19
549. MY	13	599. OWN	15	649. PRIG	6	699. RHYME	8	749. SCAB	4
550. MYTH	17	600. OX	17	650. PRIME	6	700. RIB	2	750. SCAN	6

EXHIBIT 1 (Continued).

751. SCARE	5	801. SLAP	4	811. STRIFE	1	911. TIDE	12	951. WASP	6
752. SCOUT	7	802. SLASH	15	812. STUFF	14	902. TILL	8	952. WASTE	18
753. SCOW	15	803. SLED	13	853. SUCH	1	903. TINT	20	953. WATCH	5
754. SCRATCH	17	804. SLEDGE	7	854. SUCK	2	904. TIME	15	954. WAVE	11
755. SCRUB	10	805. SLICE	20	855. SUIT	16	905. TINGE	15	955. WAYS	2
756. SCUFF	13	806. SLID	19	856. SUP	6	906. TIP	13	956. WEAK	9
757. SCYTHE	2	807. SLIDE	8	857. TAB	11	907. TIRE	16	957. WEAN	13
758. SEED	20	808. SLIP	1	858. TACK	15	908. TOAD	9	958. WEAVE	15
759. SELL	17	809. SLOUCH	6	859. TAG	10	909. TOE	1	959. WEB	20
760. SENSE	15	810. SLUDGE	2	860. TAINT	13	910. TOIL	3	960. WED	15
761. SET	12	811. SLUG	10	861. TAKE	3	911. TON	16	961. WEDGE	3
762. SHACK	8	812. SLUSH	20	862. TAN	2	912. TONGUE	6	962. WEED	18
763. SHADE	15	813. SLY	5	863. TANG	2	913. TOUCH	4	963. WEEP	17
764. SHAFT	7	814. SMART	9	864. TAP	13	914. TRADE	5	964. WEIRD	17
765. SHANK	6	815. SMASH	13	865. TEACH	15	915. TRASH	2	965. WHARF	3
766. SHARE	18	816. SMILE	1	866. TELL	14	916. TRAY	14	966. WHEAT	1
767. SHED	4	817. SMITE	14	867. TEN	9	917. TREE	10	967. WHEEL	19
768. SHEEP	16	818. SMOOTH	13	868. TENT	14	918. TRIP	3	968. WHEEZE	8
769. SHEIK	16	819. SNIFF	7	869. TEST	4	919. TROD	18	969. WHIFF	7
770. SHIN	1	820. SNIPE	10	870. THAN	9	920. TROOP	9	970. WHITE	19
771. SHINE	5	821. SNOW	11	871. THANK	9	921. TRUE	5	971. WHO	3
772. SHIP	17	822. SNUFF	2	872. THAT	15	922. TUBE	17	972. WHY	3
773. SHOCK	17	823. SO	15	873. THAW	13	923. TUCK	16	973. WIDE	15
774. SHOE	2	824. SOAK	20	874. THEM	2	924. TUG	5	974. WIELD	16
775. SHOOK	14	825. SOAP	13	875. THEME	20	925. TURF	3	975. WIFE	6
776. SHOP	11	826. SOAR	16	876. THEN	1	926. TURN	16	976. WIG	8
777. SHOT	11	827. SOB	3	877. THERE	1	927. TWEEDE	15	977. WILD	9
778. SHOUT	3	828. SOD	12	878. TICK	5	928. UP	19	978. WINK	5
779. SHOVE	5	829. SCIL	14	879. THIEF	19	929. URGE	11	979. WINE	17
780. SHRUB	15	830. SOLVE	5	880. THIGH	6	930. US	8	980. WIPE	9
781. SHRUG	14	831. SOUR	4	881. THIN	13	931. USE(YEWS)	1	981. WIRE	7
782. SHUT	12	832. SOUSE	20	882. THINE	18	932. VAGUE	14	982. WISE	20
783. SHY	19	833. SOUTH	7	883. THIS	8	933. VALVE	10	983. WISH	2
784. SICK	5	834. SPED	3	884. THORN	18	934. VAMP	2	984. WITH	9
785. SIDE	13	835. SPICE	8	885. THOSE	10	935. VASE(VACE)	5	985. WOE	7
786. SIEGE	7	836. SPLASH	19	886. THOU	16	936. VAST	2	986. WOO	7
787. SIEVE	18	837. SPRIG	11	887. THOUGH	7	937. VICE	17	987. WOOD	11
788. SIGH	20	838. SPUD	9	888. THRASH	3	938. VILE	15	988. WOVE	12
789. SIGN	11	839. SPY	11	889. THREAD	8	939. VINE	12	989. WRATH	5
790. SILL	19	840. STAB	16	890. THREE	16	940. VOID	10	990. WRECK	15
791. SIN	7	841. STAFF	10	891. THRESH	16	941. VOTE	14	991. WRIST	14
792. SING	14	842. STAG	3	892. THROAT	19	942. VOW	3	992. WRIT	6
793. SIP	9	843. START	2	893. THROB	12	943. WADE	10	993. YAWN	5
794. SIR	15	844. STARVE	4	894. THRONE	9	944. WAG	14	994. YEAR	9
795. SIT	3	845. STEAD	13	895. THROUGH	20	945. WAGE	12	995. YEAST	8
796. SIZE	3	846. STEED	19	896. THUD	5	946. WAIF	14	996. YES	19
797. SKETCH	4	847. STIFF	11	897. THUG	10	947. WAIT	6	997. YIELD	19
798. SKID	20	848. STRAP	4	898. THUS	6	948. WAKE	10	998. YOU	17
799. SKY	12	849. STRESS	16	899. TIPI	14	949. WALK	20	999. YOUTH	10
800. SLAB	14	850. STRIDE	17	900. TICK	4	950. WASH	20	1000. ZONE	5

are adequately trained, the scores are dependent upon the size of vocabulary chosen. Repeated scores on a single 50-word list will typically be as much as 50 percentage points higher than if five lists are used. Similarly, scores on 250 words can be up to 40 percentage points higher than scores when all 1000 words are used; see figure 4-5 in Kryter, Licklider, Webster, and Hawley (1963), reproduced as figure 1.

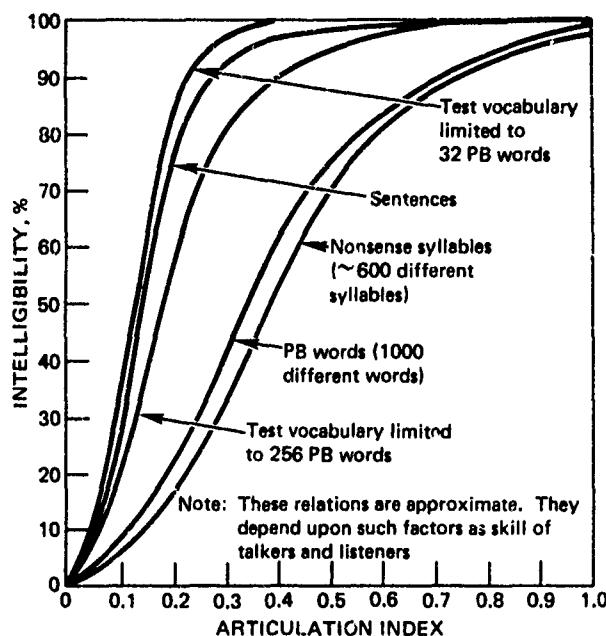


Figure 1. Sentence, PB word, and nonsense syllable intelligibility as a function of articulation index (AI).

These lists should be used with great caution, but they are excellent for evaluating GOOD SYSTEMS, or comparing one system to another, because they are sensitive to small changes AND they have been widely used in the past. Many specifications and/or comparisons to older systems will be in PB scores.

Egan (1948) recognized occasions would arise in which only 100 PB's were needed, so he constructed two R-lists. In his words, "The words were selected so that they resemble one another as much as possible....the 15 vowels and diphthongs are represented by six words each. An effort was made to distribute all the different consonant sounds among these 90 words. The remaining 10 words....are used to sample some of the compound consonants."

If 100 PB words are required for use with relatively untrained crews, randomize the R-lists shown in exhibit 2.

EXHIBIT 2: EGAN'S R-LISTS (100 SELECTED PB WORDS).

R LIST 1				
1. aisle	21. dame	41. jack	61. rack	81. still
2. barb	22. done	42. jam	62. ram	82. tale
3. barge	23. dub	43. law	63. ring	83. tame
4. bark	24. feed	44. lawn	64. rip	84. toil
5. baste	25. feet	45. lisle	65. rub	85. ton
6. bead	26. file	46. live	66. run	86. trill
7. beet	27. five	47. loon	67. sale	87. tub
8. beige	28. foil	48. loop	68. same	88. vouch
9. boil	29. fume	49. mess	69. shod	89. vow
10. choke	30. fuse	50. met	70. shop	90. whack
11. chore	31. get	51. neat	71. should	91. wham
12. cod	32. good	52. need	72. shrill	92. woe
13. coil	33. guess	53. oil	73. sing	93. woke
14. coon	34. hews	54. ouch	74. sip	94. would
15. coop	35. hive	55. paw	75. skill	95. yaw
16. cop	36. hod	56. pawn	76. soil	96. yawn
17. couch	37. hood	57. pews	77. soon	97. yes
18. could	38. hop	58. poke	78. soot	98. yet
19. cow	39. how	59. pour	79. soup	99. zing
20. dale	40. huge	60. pure	80. spill	100. zip
R LIST 2				
1. ball	21. dial	41. hen	61. peep	81. tap
2. bar	22. dig	42. huff	62. peeve	82. them
3. bob	23. dine	43. hush	63. phase	83. then
4. bong	24. ditch	44. jar	64. pull	84. title
5. book	25. doubt	45. job	65. put	85. tine
6. booot	26. dowel	46. joy	66. raid	86. tong
7. booth	27. drain	47. joys	67. raze	87. toot
8. bout	28. em	48. kirk	68. rich	88. tooth
9. bowel	29. en	49. leap	69. rig	89. tout
10. boy	30. fade	50. leave	70. ream	90. towel
11. boys	31. far	51. made	71. roe	91. toy
12. brain	32. foam	52. maize	72. root	92. toys
13. bull	33. fob	53. mew	73. rough	93. weave
14. crane	34. foe	54. muff	74. rush	94. weep
15. cue	35. foot	55. mush	75. ruth	95. while
16. curb	36. full	56. mute	76. sack	96. whine
17. curd	37. gall	57. new	77. sap	97. wig
18. curse	38. gong	58. newt	78. slain	98. witch
19. curt	39. grain	59. oh	79. tack	99. yak
20. cute	40. hem	60. ohm	80. tall	100. yap

WORD FREQUENCY (FAMILIARITY) EFFECTS

Not only is the size of the vocabulary a determinant of speech intelligibility but also the relative familiarity of the word; that is, how often the word occurs in the language. See Howes (1957), Egan (1957), Rosenzweig (1957), and Rosenzweig and Postman (1957). Therefore, Hirsh et al (1952), Lehiste and Peterson (1959), Peterson and Lehiste (1962), Carhart, Tillman, and Wilbur (1963), Tillman, Carhart, and Wilbur (1965), and Tillman and Carhart (1966) compiled lists of more familiar PB or CNC* words. Exhibit 3 gives the Hirsh et al (1952) lists of 200 words known as CID Test W-22. Exhibit 4 gives the Peterson and Lehiste (1962) lists of 500 words, and exhibit 5 gives the Tillman and Carhart (1966) lists of the 200 words known as Northwestern University Auditory Test 6 developed for the Air Force. NU Auditory Test 6 was designed for greater homogeneity among lists than the W-22. If 200 PB words are desired, randomize exhibit 5, and if 500 are required, randomize exhibit 4. Exhibit 4 is particularly important because the familiarity of the words in terms of the Thorndike and Lorge (1952) count is given. The words in exhibit 5 are used extensively in the USAF both clinically and for in-flight tests of air crewmen with suspected hearing losses.

*Consonant Vowel Nucleus Consonant

EXHIBIT 3: HIRSH ET AL W-22 LISTS (200 FAMILIAR PB WORDS).

<i>List 1</i>	<i>List 2</i>	<i>List 3</i>	<i>List 4</i>
1. ace	1. ail	1. add	1. aid
2. ache	2. air	2. aim	2. all
3. an	3. and	3. are	3. am
4. as	4. been	4. ate	4. arm
5. bathe	5. by	5. bill	5. art
6. bells	6. cap	6. book	6. at
7. carve	7. cars	7. camp	7. bee
8. chew	8. chest	8. chair	8. bread
9. could	9. die	9. cute	9. can
10. dad	10. does	10. do	10. chin
11. day	11. dumb	11. done	11. clothes
12. deaf	12. ease	12. dull	12. cock
13. earn	13. eat	13. ears	13. darn
14. east	14. else	14. end	14. dolls
15. felt	15. flat	15. farm	15. dust
16. give	16. gave	16. glove	16. ear
17. high	17. ham	17. hand	17. eyes
18. him	18. hit	18. have	18. few
19. hunt	19. hurt	19. he	19. go
20. isle	20. ice	20. if	20. hang
21. it	21. ill	21. is	21. his
22. jam	22. jaw	22. jar	22. in
23. knees	23. key	23. king	23. jump
24. law	24. knee	24. knit	24. leave
25. low	25. live	25. lie	25. men
26. me	26. move	26. may	26. my
27. mew	27. new	27. nest	27. near
28. none	28. now	28. no	28. net
29. not	29. oak	29. oil	29. nuts
30. or	30. odd	30. on	30. of
31. owl	31. off	31. out	31. ought
32. poor	32. one	32. owes	32. our
33. ran	33. own	33. pie	33. pale
34. see	34. pew	34. raw	34. save
35. she	35. rooms	35. say	35. shoe
36. skin	36. send	36. shove	36. so
37. stove	37. show	37. smooth	37. stiff
38. them	38. smart	38. start	38. tea
39. there	39. star	39. tan	39. tin
40. thing	40. tear	40. ten	40. than
41. toe	41. that	41. this	41. they
42. true	42. then	42. three	42. through
43. twins	43. thin	43. though	43. toy
44. up	44. too	44. tie	44. where
45. us	45. tree	45. use	45. who
46. wet	46. way	46. we	46. why
47. what	47. well	47. west	47. will
48. wire	48. with	48. when	48. wood
49. yard	49. young	49. wool	49. yes
50. you	50. your	50. year	50. yet

Alphabetical Lists of the Words in Auditory Test W-22

**EXHIBIT 4: PETERSON AND LEHISTE CNC LISTS
(500 FAMILIAR PB WORDS).**

CNC List 1		CNC List 2	
Word	Frequency	Word	Frequency
1. bean*	43	1. beam*	41
2. boat	AA 1000	2. beg	A
3. boil	A	3. bought*	A
4. cape*	34	4. car*	AA 500
5. check*	AA (cheque)	5. choice	A
6. chore	3	6. choose*	A
7. dead*	AA 1000	7. coat	AA 1000
8. dime*	11	8. cob*	2
9. ditch*	28	9. dam	19
10. fall*	AA 500	10. (damn)	(18)
11. fit*	AA 1000	10. dire	8
12. gale	15	11. dodge*	16
13. goose*	45	12. fake*	3
14. hate*	A	13. fern*	13
15. home	AA 500	14. gain	AA 1000
16. hull*	3	15. germ	10
17. jar	43	16. goal	21
18. jug*	8	17. hash*	2
19. king	AA 500	18. hide*	A
20. kite*	10	19. hill*	AA 1000
21. knife*	A	20. jet	9
22. lag*	9	21. late	AA 500
23. lease	14	22. lead [lid]	AA 1000
24. loop	15	23. leak	8
25. make	AA 500	24. (leek)	(1)
26. merge*	6	24. love*	AA 500
27. mess	17	25. met	AA 1000
28. name	AA 500	26. moon	AA
29. pad*	17	27. much	AA 500
30. patch*	34	28. nose*	AA 1000
31. pick*	AA 1000	29. (knows)	(AA 500)
32. ripe*	34	29. nurse	A
33. rose*	AA 1000	30. pan*	A
(rows)	(A)	31. pave	14
34. rout*	8	32. puff*	28
35. salve*	3	33. rail	A
36. seize	A	34. red	AA 500
(sees)	(AA 500)	35. ring	AA 1000
(seas)	(AA 500)	(wring)	(9)
37. shirt	47	36. root* [rut]	A
38. shore	AA 1000	(route)	(A)
39. sob*	36	37. sap*	18
40. sun	AA 500	38. ship*	AA 500
(son)	(AA 500)	39. should	AA 500
41. thin*	AA 1000	40. soul	AA 1000
42. toad*	15	(sole)	(25)
(towed)	(9)	41. south*	AA 1000

EXHIBIT 4 (Continued).

CNC List 1		CNC List 2	
Word	Frequency	Word	Frequency
43. tooth	47	42. suck*	15
44. tough	18	43. tall	AA 1000
45. van	29	44. talk	AA 500
46. wheel* [mil]	A	45. this*	AA 500
47. wish*	AA 500	46. tire*	AA 1000
48. wood* (would)	AA 1000 (AA 500)	47. vine*	38
49. wreck*	41	48. wag*	12
50. yearn	10	49. weep	38
50. which [mitʃ]		AA 500	
CNC List 3		CNC List 4	
Word	Frequency	Word	Frequency
1. bar*	A	1. birch	16
2. bell*	A	2. bone	A
(belle)	(13)	3. bug*	1G
3. bush*	A	4. can	AA 500
4. chin	27	5. cash	46
5. dab*	2	6. chief	AA 1000
6. dike*	4	7. chum	4
(dyke)	(1)	8. date	AA 1000
7. dip*	34	9. deal	AA 1000
8. fade*	41	10. dose* [doʊs]	8
9. faith	A	11. foot*	AA 1000
10. four*	AA 500	12. gas*	A
(fore)	(11)	13. give*	AA 500
(for)	(AA 500)	14. him*	AA 500
11. gap*	17	15. hire*	A
12. gull*	5	16. hoof* [huf]	26
13. head	AA 500	17. job*	AA 1000
14. house [haus]	AA 500	18. keep	AA 500
15. hut*	32	19. lap*	36
16. jail	22	20. loan	30
(gaol)	(1)	(lone)	(22)
17. joke*	32	21. long	AA 500
18. keen	35	22. loud*	A
19. keg	3	23. mill	A
20. kid*	A	(mil)	(1)
21. lake	AA 1000	24. mirth	16
22. leave*	AA 500	25. mop*	5
23. life*	AA 500	26. net*	A
24. man	AA 500	27. nice*	AA 1000
25. mate	48	28. pack*	A
26. more	AA 500	29. pause	A
27. noise	A	(paws)	(29)
28. numb	5	30. phone*	20
29. perch*	23	31. pool	34
30. piece	AA 1000	32. rage*	49
(peace)	(AA 1000)	33. read* [rid]	AA 500
31. pod*	3	(reed)	(22)

EXHIBIT 4 (Continued).

CNC List 3		CNC List 4	
Word	Frequency	Word	Frequency
32. purge*	6	34. rice*	38
33. rat*	37	35. said	AA 500
34. rig	6	36. serve	AA 500
35. room [rum]	AA 500	37. shake	A
36. rouge* [ruʒ]	9	38. shut*	A
37. sheep*	A	39. sock	12
38. shine*	A	40. take*	AA 500
39. size*	AA 1000	41. thumb	27
(sighs)	(A)	42. till*	AA 1000
40. soon	AA 500	43. tower	A
41. sung	16	44. void*	12
42. toll	10	45. wail	20
43. tone	A	46. war	AA 500
44. toss	46	(wore)	(A)
45. vote*	AA	47. when [wen]	AA 500
46. well	AA 500	48. wig*	10
47. what [Mat]	AA 500	49. write	AA 500
48. with* [wid]	AA 500	(right)	(AA 500)
49. work	AA 500	50. youth*	AA
50. yam	1		

CNC List 5		CNC List 6	
Word	Frequency	Word	Frequency
1. back*	AA 500	1. bad*	AA 1000
2. bathe*	39	2. bed	AA 1000
3. beach	A	3. birth*	A
(beech)	(10)	4. bud*	30
4. boot	37	5. cage*	30
5. cab*	15	6. calf*	14
6. care	AA 500	7. cat*	A
7. chalk	13	8. chain*	AA 1000
8. coal	AA 1000	9. cheese*	45
(cole)	(2)	10. cool	AA 1000
9. cup*	AA 1000	11. dig*	43
10. dawn	A	12. door	AA 500
11. dim	37	13. dull*	48
12. dock	16	14. fan*	38
13. five*	AA 500	15. fire	AA 500
14. food*	AA 500	16. get*	AA 500
15. gaze	A	17. gone	AA 500
16. good*	AA 500	18. hike*	10
17. half	AA 500	19. hiss*	16
18. hot*	AA 1000	20. howl*	34
19. hush*	26	21. jam*	16
20. juice	37	22. jot [dʒat]	3
21. knit*	30	23. knock	A
22. lean	A	24. lawn	37
23. light	AA 500	25. live [liv]	AA 500

EXHIBIT 4 (Continued).

CNC List 5		CNC List 6	
Word	Frequency	Word	Frequency
24. limb	38	26. look*	AA 500
25. luck	46	27. map*	A
26. match	A	28. mode*	23
27. mean	AA 500	(mowed)	(6)
28. myth*	8	29. move*	AA 500
29. nag*	5	30. niece*	10
30. nudge*	2	31. night*	AA 500
31. peg*	9	(knight)	(AA 1000)
32. pull	AA 1000	32. pace	A
33. purse*	38	33. pole	A
34. raid*	11	(poll)	(17)
35. robe*	31	34. pope	26
36. rough*	A	35. raise*	AA 1000
(ruff)	(1)	(raze)	(2)
37. sail	AA 1000	(rays)	(A)
(saie)	(A)	36. rug*	40
38. shop*	AA 1000	37. rush*	AA 1000
39. sing	AA 1000	38. search	A
40. sore*	38	39. shock*	A
41. tease	14	40. shone	34
(teas)	(A)	41. sit*	AA 1000
42. tell*	AA 500	42. sour*	15
43. then*	AA 500	43. team	A
44. thought	AA 500	(teem)	(6)
45. town	AA 500	44. tube*	32
46. veil	30	45. turn*	AA 500
(vale)	(13)	46. veal	5
(vail)	(1)	47. web*	14
47. wire*	A	48. whip [Map]	41
48. worm	37	49. wife*	AA 500
49. yoke	13	50. wing	AA 1000
(yolk)	(3)		
50. zeal	15		
CNC List 7		CNC List 8	
Word	Frequency	Word	Frequency
1. bet*	23	1. bag	AA 1000
2. big*	AA 500	2. bath*	46
3. bun	4	3. bite	33
4. call	AA 500	4. calm	A
5. caught	AA 1000	5. cheap*	A
6. cheek	A	6. cough	18
7. coke	5	7. cub*	11
8. did*	AA	8. daze	12
9. doom	20	(days)	(AA 500)
10. dumb*	34	9. den	23
11. face	AA 500	10. dive*	21
12. far*	AA 500	11. foam*	21

EXHIBIT 4 (Continued).

CNC List 7		CNC List 8	
Word	Frequency	Word	Frequency
13. fish	AA 1000	12. fuss*	11
14. geese	26	13. gag	3
15. gem*	24	14. gear	9
16. gun*	A	15. gin*	9
17. have*	AA 500	16. guide	AA 1000
(halve)	(2)	17. hail	40
18. heat*	AA 1000	(hale)	(7)
19. hole*	AA 1000	18. hoop	8
(whole)	(AA 500)	(whoop)	(7)
20. join	AA 1000	19. hurl*	20
21. laugh*	AA 500	20. jerk	18
22. led*	AA 1000	21. lash*	22
23. loot	3	22. learn	AA 500
24. lose*	AA 1000	23. loathe	7
25. mine	AA 1000	24. lock	A
26. mole	14	25. moss	22
27. mouth*	AA 1000	26. muff*	5
28. nap*	15	27. near	AA 500
29. neck*	AA 1000	28. noose*	2
30. note*	AA 500	29. page*	AA 1000
31. pass*	AA 500	30. poor	AA 500
32. pearl*	47	31. pose	10
33. pine	A	32. rain	AA 1000
34. reach*	AA 500	(reign)	(44)
35. rib*	31	33. real*	AA 500
36. ridge*	31	(reel)	(19)
37. sack*	30	34. road*	AA 500
(sac)	(1)	(rode)	(A)
38. save	AA 1000	(rowed)	(A)
39. shall	AA 500	35. rot*	8
40. side*	AA 500	36. sad	A
(sighed)	(A)	37. seek	AA 1000
41. such*	AA 500	38. shawl	9
42. sure	AA 500	39. shoot	A
43. tape	8	40. some	AA 500
44. tar	10	41. there*	AA 500
45. third	AA 1000	(their)	(AA 500)
46. top	AA 1000	42. thing	AA 500
47. vague*	20	43. tin	36
48. was	AA 500	44. tip*	A
49. wit	A	45. touch*	AA 1000
50. young	AA 500	46. vowel	5
		47. wake*	A
		48. week*	AA 500
		(weak)	(A)
		49. wet	A
		50. wheat* [mit]	A

EXHIBIT 4 (Continued).

CNC List 9		CNC List 10	
Word	Frequency	Word	Frequency
1. ball*	AA 1000	1. bake	A
(bawl)	(6)	2. bit*	AA 1000
2. beat	AA 1000	3. burn	AA 1000
(beet)	(11)	4. cause	AA 500
3. book*	AA 500	(caws)	(4)
4. both	AA 500	5. cave*	33
5. catch*	AA 1000	6. chat*	12
6. chair*	AA 1000	7. chill*	43
7. cheer	A	8. coin	A
8. curve*	36	9. cone	7
9. cut*	AA 500	10. death*	AA 1000
10. deck*	A	11. deep*	AA 1000
11. dish*	A	12. din*	11
12. dog*	AA 1000	13. fine*	AA 500
13. feet*	AA 500	14. fool*	AA 1000
(feat)	(13)	15. gore	7
14. fudge*	1	16. guess*	AA 1000
15. girl	AA 500	17. hair	AA 1000
16. got*	AA 500	(hare)	(18)
17. ham	17	18. hit*	A
18. haze	5	19. hurt*	AA 1000
(hays)	(46)	20. jade*	4
19. hen	49	21. judge*	AA 1000
20. jazz*	5	22. load	A
21. lack	A	(lode)	(1)
22. lathe*	2	23. loose*	A
23. lip*	AA 1000	24. lot	AA 1000
24. loaf	17	25. lung	15
25. mire	7	26. meek	7
26. mob	20	27. mood*	27
27. mud*	47	28. mouse	34
28. nail	A	29. neat*	29
29. need*	AA 500	30. nick*	5
(knead)	(5)	31. palm	37
30. pill	7	32. path*	AA
31. power	AA 500	33. peak	28
32. pun*	1	(peek)	(3)
33. rag*	28	34. pile*	A
34. reap*	14	35. ride*	AA 1000
35. roof [ruf]	AA	36. rob*	41
36. sane	11	37. rope*	A
37. shade*	AA 1000	38. run	AA 500
38. shout*	AA 1000	39. safe	AA 1000
39. sin*	A	40. sag*	5
40. soap*	37	41. sell*	AA 1000
41. thine*	19	42. shack*	7
42. time*	AA 500	43. sub	1
43. tick*	12	44. term	A

EXHIBIT 4 (Continued).

CNC List 9		CNC List 10	
Word	Frequency	Word	Frequency
44. tool	40	45. thatch	6
45. voice	AA 500	46. towel	18
46. watch*	AA 500	47. wash* [wɔʃ]	AA
47. white* [wait]	AA 500	48. while [mail]	AA 500
48. word	AA 500	49. witch	24
49. wrong	AA 500	50. your [jur]	AA 500
50. yes*	AA 500		

*Also included in PB lists.

EXHIBIT 5: TILLMAN AND CARHART NORTHWESTERN
UNIVERSITY AUDITORY TEST 6.

List I		List II	
1. BEAN	26. MET	1. BITE	26. MERGE
2. BOAT	27. MODE	2. BOOK	27. MILL
3. BURN	28. MOON	3. BOUGHT	28. NICE
4. CHALK	29. NAG	4. CALM	29. NUMB
5. CHOICE	30. PAGE	5. CHAIR	30. PAD
6. DEATH	31. POOL	6. CHIEF	31. PICK
7. DIME	32. PUFF	7. DAB	32. PIKE
8. DOOR	33. RAG	8. DEAD	33. RAIN
9. FALL	34. RAID	9. DEEP	34. READ
10. FAT	15. RAISE	10. FAIL	35. ROOM
11. GAP	36. REACH	11. FAR	36. ROT
12. GOOSE	37. SELL	12. GAZE	37. SAID
13. HASH	38. SHOUT	13. GIN	38. SHACK
14. HOME	39. SIZE	14. GOAL	39. SHAWL
15. HURL	40. SUB	15. HATE	40. SOAP
16. JAIL	41. SURE	16. HAZE	41. SOUTH
17. JAR	42. TAKE	17. HUSH	42. THOUGHT
18. KEEN	43. THIRD	18. JUICE	43. TON
19. KING	44. TIP	19. KEEP	44. TOCK
20. KITE	45. TOUGH	20. KEG	45. TURN
21. KNOCK	46. VINE	21. LEARN	46. VOICE
22. LAUD	47. WEEK	22. LIVE	47. WAG
23. LIMB	48. WHICH	23. LOAF	48. WHITE
24. LOT	49. WHIP	24. LORE	49. WITCH
25. LOVE	50. YES	25. MATCH	50. YOUNG

EXHIBIT 5 (Continued).

List III	List IV
1. BAR	26. HOUSE
2. BASE	27. NAME
3. BEG	28. NOTE
4. CAB	29. PAIN
5. CAUSE	30. PEARL
6. CHAT	31. PHONE
7. CREEK	32. POLE
8. COOL	33. RAT
9. DATE	34. RINC
10. DITCH	35. ROAD
11. DODGE	36. RUSH
12. FIVE	37. SEARCH
13. GERM	38. SEIZE
14. GOOD	39. SHALL
15. GUN	40. SHEEP
16. HALF	41. SOUP
17. HIRE	42. TALK
18. HIT	43. TEAM
19. JUG	44. TELL
20. LATE	45. THIN
21. LTD	46. VOID
22. LIFE	47. WALK
23. LUCK	48. WHEN
24. MESS	49. WIRE
25. HOP	50. YOUTH
	1. BACK
	2. BATH
	3. BONE
	4. CAME
	5. CHAIN
	6. CHECK
	7. DIP
	8. DOG
	9. DOLL
	10. FIT
	11. FOOD
	12. GAS
	13. GET
	14. HALL
	15. HAVE
	16. HOLE
	17. JOIN
	18. JUDGE
	19. KICK
	20. KILL
	21. LEAN
	22. LEASE
	23. LONG
	24. LOSE
	25. MAKE
	26. HOB
	27. HOOD
	28. NEAR
	29. NEAT
	30. PASS
	31. PEG
	32. PERCH
	33. RED
	34. RIPE
	35. ROSE
	36. ROUGH
	37. SAIL
	38. SHIRT
	39. SHOULD
	40. SOUR
	41. SUCH
	42. TAPE
	43. THUMB
	44. TIME
	45. TIRE
	46. VOTE
	47. WASH
	48. WHEAT
	49. WIFE
	50. YEARN

NUMBER OF RESPONSE ALTERNATIVES

Another factor affecting the quantitative intelligibility score is the number of response alternatives. As far as word tests are concerned, the first practical multiple-choice answer sheet test was developed by Haagen (1946) and used extensively at the Navy Electronics Laboratory in applied studies on competing messages (in air control towers). see Webster and Thompson (1954). These tests were updated and used extensively by Black, Tolhurst, and Morrell (1953) and Black (1957) at the USN School of Aviation Medicine. Black's list and the answer sheet foils are shown in exhibit 6.

In these tests the talker is given a list of words to read and the listeners mark prepared blanks on which each word read appears as one of four similar words. The listeners require no special training: the talker reads three words, then pauses 2 seconds, allowing time for the listener to respond. This is a relatively short-duration test of about 1 minute for 27 words. It is not phonetically balanced.

Extensively used phonetically-balanced, limited-choice, answer-sheet tests have been developed by Fairbanks (1958), House et al (1965), and Kreul et al (1968). Exhibits 7 and 8 show the 250 Fairbanks (1958) words, an answer sheet, and the methods used to construct talker lists and randomization. In general, there is a one-out-of-five chance of guessing the

EXHIBIT 6: BLACK'S MULTIPLE-CHOICE WORD TESTS

Speaker 1 is		
1 groove	modern	vice
drew*	moderate	light*
crew	modesty*	mice
grew	modest	bite
say	forbade	chink
stay	pervade	kink*
stayed*	surveyed	check
spade	survey*	chin
stung	drunk	intent
stun	brunt	intend
stunned*	runt*	content
quench	busy	ende*
went	physics*	waves
whence	physic	wave
when*	visit	way
pass	clearly	fin:
past*	weary*	find*
cast	quarry	sign
task	query	kind
popular	nurse	get
poplar	first*	gap
hopper*	birth	guess
opera	burst	guest*
immense	named	only
commence	name	woman*
emit	main*	pullman
cement*	knaves	omen
latter	last	swain*
ladder*	lash	slain
lattice	laugh*	flame
rabbit	glass	plain
crash	gold	fail*
crab	bow!	poor
craft	cold*	polo
crack*	bold	palace

Speaker 2 is		
1 ninety	drum	harrow
nineteen	rung	peril
nightly*	rum*	herald*
nine	run	arrow
ran	putter	need
rank	tucker*	lead
rang*	pocket	lean
tag	pucker	leave*
kick	sec*	depot
tick*	seed	people
pick	seize	equal*
hick	seize	decoy
shower	earthen	bath
scholar	earthly	bat*
sour*	urban*	bad
scour	bourbon	back
berry	spring	listless
carry	pray*	distress*
bearing*	spray	restless
very	spread	blissful
mouse	Saturn	fog*
mouth	sat	bar
now	second	bog
mount*	satin*	bug
quarter	feit*	horrible
fortress	belt	orchid
portrait	dealt	orphan
porter*	bell	organ*
heavy	did	dolar
happen*	live	jealous*
package	led*	zealous
happy	lid	develop
hamper	tendon	pond
pamper	tender	on
panther*	pendant*	hound*
pamphlet	pendulum	pawn

Speaker 3 is		
1 apply	gift*	lamp
supply	if	lance
amply*	hit	glance*
fly	it	land
bust	handle*	free
fuss*	anvil	freeze
but	amble	freed
bus	ample	tree*
airy	fed	laugh
hairy*	stead*	glad*
arid	spend	lash
carry	sped	flash
throw	low	red*
froze	rose	brown
prose	loathsome	brow
probe*	lonesome*	proud
desk	stance	science
depth	stand*	silent
dead	stamp	sound
death*	spent	silence*
broke	code	begun*
growth*	told	begot
throat	cold	forgot
wrote	coal*	deduct
sister	hulk*	mild
system*	halt	mile*
cistern	pulp	miles
pistol	fax!	mine
strike	limp	town
spite	limb	townsman
fight*	lend*	bondsmen
spike	lent	count*
paid	cute	fell
page*	cunning*	spell
age	honey	felled*
haze	puny	bell

Speaker 4 is		
1 much	uplift	cypress
mud	uproot*	cipher
month	approve	siphon
monk*	group	sightless*
twelve	mind*	blister
well*	mild	blissful
dwell	mine	listful*
weld	line	wistful
wren	barter	found
went	barker	crown*
rent	sparkle	cloud
lent*	parker*	clown
guide	lively	love*
die	widen*	lull
died*	wisely	low
dive	widely	lag
stove	amiss	equipped
sold	omit	acquit
stole	amid	equip*
soul*	emit*	quit
reverse	sired*	simple
traverse*	siren	dimple*
perverse	fire	pimple*
pervert	sire	temple
drove	warrant	dog
stroke*	one	gone
strode	warm	don
stroke	warn*	darn*
fire	stale	evil
hire*	jail	easel*
tired	dale	measles
tire	gate*	needle
gaily	barn	lip
fail	bark	ift
daily*	bought*	hisp
five	spark	list*

Speaker 5 is		
1 crash	least	wouldn't
drag	lease	wood
trash	nicce*	wooden
thrash*	leaf	wooded*
pillow	peg	loosely
pillar	keg	gruesome
killer*	egg	lozen*
filler	pay*	nuisance*
lava	wait	hour
loud	which	how
lock	wake*	howl*
robber*	wig	owl
glad	fable	part
lad	tablet	art
laugh	habit	heart
lag*	cattle*	arch*
puncture	sigh*	bake
teacher	size	bait*
tincture	side	fate
picture*	scythe	faith
tempt	green	seller
tense	cream	solemn*
lent	tree	solid
liemp*	creed*	sullen
youth	allege	muster
you	away	lustly
use	allayed*	bluster*
mute*	alay	luster
tight*	birds	chat*
pike	bird	cap
height	birth*	check
hike	burden	chap
devise	chaff*	Ed*
defy	shaft	head
divide	chap	add
beside*	shack	ebb

Speaker 6 is		
1 feel	fruit*	pelvis*
deal	true	elder
steal	troop	elbow
veal*	she	eldest
tasty	sheep	add
hasty	shield	ask
hasten	she	as
pastry*	sheath*	has*
wrist*	depth*	fortune
risk	death	fort*
rip	deal	important
list	guest	forty
shoe	defense	hamper
choose	methinks	tamper
too*	repent	hampered*
chew	bethinks*	hamburg
iced	palace	stow
red	palate	stole
ledge	talent*	stowed*
leg	pilot	stove
butter	heat	tick
flutter	hate*	chicken*
flood	paint	ticket
fluttered*	ink	picket
thumb	coy	auto
from*	toy	bottom
come	tore	often*
sum	torque*	autumn
bower	fast	sit
borrow	fact	six
flower*	fat	sick
power	that*	sift*
deceive	cars*	heard
precede	carve	verge*
concede*	card	urge
receive	car	herb

Correct responses (items) are underlined and the items of alternate lists are designated by asterisks.

EXHIBIT 6 (Continued).

Speaker 7 is

1	providence	worse	pledge*
2	problem	work	sled
3	promise	worst	sledge
4	province*	worth*	sleigh
5	row	wearing*	stomach
6	throw	wearer	staunch
7	grove*	wary	stark
8	grow	wear	starch*
9	suffer	scram	grandsire
10	zipper*	swing	grandstand
11	supper*	slam*	transpire*
12	zephyr	swam	grandchild
13	bathe	reverse	anew
14	save*	invert*	unused*
15	space	divert	amuse
16	spade	revert	unuse
17	depth	dangling	bristle
18	deck	sandy	brittle
19	death*	sandwich*	ripple
20	debt	sanguine	riddle*
21	attend*	bond	steward
22	akin	fold	sewer
23	attempt	bowl*	stool
24	again	hole	Stewart*
25	break	spurt	increase
26	rate*	stirrup	entreat
27	rape	stirrile	retreat
28	rake	syrup*	intrigue*
29	tack	souse*	mystery
30	tax	south	mystic
31	facts*	sound	mischief
32	tact	sack	inisty*
33	anew	bake	rhythm
34	balloon	date*	written*
35	aloof*	bait	ridden
36	allude	fake	ribbon

Speaker 8 is

1	eighty	acres*	trump*	irk*
2	aching*	achin*	truck	hurt
3	eight	trunk	earth	heard
4	delude	head*	gauge	
5	remove	edge	gaze	
6	elude	fedge	gave	
7	renew*	egg	gay*	
8	can't	arm	flatter*	
9	scant	arm'd*	climate	
10	scamp	on	planet	
11	scan*	odd	plant	
12	find	purse*	fitness	
13	bind	burst	thickness	
14	vine*	hurt	sickness*	
15	fine	first	picnic	
16	dumb	bedroom	royal	
17	gum*	reverend*	broil	
18	dump	brother	broiled*	
19	done	brethren	boil	
20	snout	wide	afford*	
21	smelt*	why	aphor	
22	snub	wise	accord	
23	snap	ride*	afore	
24	stead	price	bury	
25	dead	Christ*	barely	
26	sped*	fight	fairyly	
27	bed	strike	fairly*	
28	white	gown	error	
29	poison	down	errand	
30	hoist	gam	barren	
31	voice*	gauze*	Arab*	
32	next*	racket*	drab	
33	nets	blacken	draft	
34	mix	blackened	graft	
35	neck	black	grab*	

Speaker 9 is

1	bite	abhor	pulse
2	bike	applause	fault
3	vice	applaud	pulp
4	fight*	apply*	false*
5	apace	runny	goose
6	attain	rubbish	noose
7	face	ready	use
8	aface*	ruddy*	deuce*
9	bruice	by	rather
10	brood	spy*	letter
11	brew*	fire	lever*
12	cruise	five	leather
13	bramble	love	hence
14	scramble	mark*	tense
15	gravel*	large	tent
16	ramble	lark	hint*
17	stain	patron	train*
18	stink	patient*	crane
19	sting	hasten	brain
20	sing*	paper	frame
21	groom	cub	listen
22	prune	tug	christen
23	broom	tough*	Christmas
24	room*	tub	prison*
25	handsome	parcel	fear*
26	cancer*	hardly	peer
27	camphor	partly*	hear
28	cancel	parsley	tear
29	suit	cotton	neither*
30	soon*	coffin	meter
31	soothe	coffee	meager
32	sue	copy*	leader
33	steam	hump	exalt*
34	seen	hunt	result
35	speed	pump	gulf
36	esteem*	punk*	exhaust

Speaker 10 is

1	artist	vesper*	knoll
2	harness*	fester	known
3	harvest	pester	no
4	orchid	festive	mold*
5	simple	bomb	Boston
6	sinful	bound	frosty
7	summon	bond	icing
8	stomach*	barn*	cross
9	litter	wrestle	popc
10	little	rascal	hope
11	glitter*	capture	oak
12	liquor	raffle*	post*
13	main*	twelve	march
14	mink	welt	margin
15	make	wealth*	marching
16	mate	twelfth	Martin*
17	lengthen	geese	rain*
18	ointment	cast	wing
19	Lincoln*	meat*	green
20	link	yeast	ring
21	bud	rough	hearing
22	bus*	drunk	hairy*
23	bust	rump	carry
24	but	rump*	herring
25	pleasant	widen	saint
26	pheasant	wide	safe
27	peasant*	wife	faint
28	present	wagon*	sink*
29	winter*	model	log
30	winner	marvel	lawn
31	where	marvicious	blond
32	woman	marble*	long*
33	lose*	itself	mash*
34	loose	excel	gnash*
35	root	sell	smash
36	blue	himself*	nag

Speaker 11 is

1	toward	feeling	dome
2	forge	dealer*	don't*
3	ford	fever	zone
4	board*	feeler	stone
5	destroy*	girl	flicker
6	deprive	pearl	clipper
7	defraud	curled*	liquor
8	defrost	curl	quicker*
9	chart*	frightful*	sultry
10	short	rifle	culprit
11	shark	greatful	sculpture*
12	sharp	highful	sculptor
13	native	pearl	calp
14	navy*	crow	cad*
15	naked	throw*	calves
16	nature	grow	cab
17	lathe	candy	ink
18	lay	pantry	pinch
19	laid*	pansy	inch
20	leg	handy*	hint*
21	thus	legend	hit
22	bust	ledger	fist
23	duck	leaden*	this*
24	dust*	lesson	kiss
25	bulb	cut	net
26	bulge	carpet	met*
27	bald*	cotton	neck
28	ball	copper*	nest
29	breast	Capital	glass*
30	friend*	hapless	lad
31	breath	hairless*	blast
32	bread	happen	black
33	harbor	soft	hood*
34	harder	sought	could
35	artist*	salt	put
36		sulk*	good

Speaker 12 is

1	needle	large	haven*
2	evil	lodge	heaven
3	meal*	lie	even
4	neither	live*	able
5	dimple	interest	cast
6	gentle	penguin	past
7	devil*	hindrance	pass*
8	dental	kindred*	path
9	armload	pen*	wooden*
10	armholed	ten	woody
11	armhole	tend	wood
12	armful	tent	witty
13	gem	glaze	creeping
14	gent	play	greeting*
15	gin	blade	greedy
16	gy'm*	blaze*	reading
17	flush	size	waitful*
18	pledge	sigh	wake
19	fresh	scythe*	wasteful
20	flesh*	side	wakeful
21	auburn	astride	dial*
22	often	ascrbe	guile
23	author*	prescribe	vial
24	autumn	describe*	guide
25	nest	rug	harrow*
26	mess	love	herald
27	meant*	rough*	arr w
28	met	rub	peril
29	gram	bench*	nuptial*
30	raise	theft	nocturnal
31	raid	fetch	nutshell
32	rage*	thatch	neptune
33	flap'er	stole*	wallet
34	leonard	stone	swallow*
35	leper	schoo!	wall
36	letter	scold	wallow

EXHIBIT 6 (Continued).

Speaker 13 is			
1	virtue merchant virgin <u>burden</u>	blend land when <u>lend</u>	fort* dwarf thwart <u>quart</u>
2	birth first <u>verse</u> burst*	casual passion peasant* <u>pageant</u>	bud bug budge <u>fudge*</u>
3	wench <u>quench</u> clinch* went	caught pot* hot <u>fox</u>	bottle vomit bomber <u>bonnet*</u>
4	pious highest bias* higher	beat* beef eat <u>deep</u>	loop root loose <u>root*</u>
5	deface* debate base <u>debase</u>	bridle* vital rifle <u>Bible</u>	beach seed see* <u>siege</u>
6	flare fire fighter* <u>player</u>	pose hose cold <u>hold</u>	left laugh let* <u>lamp</u>
7	stun stung <u>sun</u> sung*	peppy* petty <u>penny</u>	bring* break <u>brunk</u> drink
8	frankness Franklin practice* frankly	soil boil <u>coil</u>	call is palace pilot <u>palate</u>
9	crave phrase* <u>praise</u> pray	limit women linen <u>lemon</u>	third* thoroughly heard <u>bird</u>

Speaker 14 is			
1	mouse mountain mount mouth*	drink bring spring*	towel* Holland hallow <u>hallow</u>
2	quarter porter order* <u>border</u>	dove dope dough <u>dull*</u>	cook approach croak* <u>broke</u>
3	dull gulf <u>guilt</u> dog	detect effect deflect <u>defect*</u>	hinge* tinge <u>pin</u> king
4	effect infect inspect <u>confess*</u>	goat scope spoke* <u>stake</u>	hash* add ask <u>ash</u>
5	root group droop* <u>roof</u>	wash watch why <u>walk*</u>	doubtless* thoughtless <u>dauntless</u> darkness
6	shell chow <u>shall</u> * child	try cry <u>fry</u> pry*	staple* stable <u>spacious</u>
7	sudden sun seven <u>southern</u> *	front* punch punt <u>hunt</u>	rauze* cause* guard <u>dog</u>
8	cuss put <u>pus</u> * push	green dream* greed <u>grieve</u>	razor rausin* reason <u>brazen</u>
9	talk toss <u>taugh</u> * hat	happy alter happily <u>athletic*</u>	repress depress* regret <u>request</u>

Speaker 15 is			
1	urge heard purge <u>courage</u>	envy* engine <u>ending</u> pending	cobweb cobbier problem <u>copper*</u>
2	scallop scholar scout <u>gallop*</u>	gild* fill hill <u>ill</u>	fog live bog <u>by*</u>
3	bless* less left <u>last</u>	often author <u>auto</u> offer*	perish parent carrot* <u>parrot</u>
4	bridge rich* <u>ridge</u> rig	downing* doubt <u>downy</u> down	grace brake brace <u>great*</u>
5	even beacon* deacon <u>deepen</u>	fear beer <u>beard</u> dear*	deluge elude delude* <u>villafe</u>
6	settle subtle settled* <u>seven</u>	list lisp <u>left</u> * lip	gallon* gallop <u>galley</u> gallant
7	hung hum tongue* <u>come</u>	listful* wistful <u>whisper</u> wishful	day* bay days <u>bathe</u>
8	meager maker meter <u>edge</u>	kill till <u>fill</u> pil	brook rook <u>cook</u> roof
9	caught talk <u>taught</u> * trough*	bring gun* <u>brum</u> grum	repute refuse <u>refute</u> compute

Speaker 16 is			
1	decides <u>besides</u> beside decide*	hate taste <u>hast</u> * paste*	pamper tamper* hamper <u>pamphlet</u>
2	spinach clinic senate* <u>eynic</u>	all fog <u>fall</u> hall	dored dove goes* <u>doze</u>
3	litter lizard whether <u>blizzard</u>	fat back <u>spat</u> stack*	mouth moss moth* <u>malt</u>
4	in hinge pin <u>king</u> *	rubbish radish reddish <u>ready</u> *	hate take cake* <u>intake</u>
5	scared secret safety <u>sacred</u>	aid aim paid <u>age</u> *	lava Florida luva <u>larger</u>
6	plant slam <u>slant</u> <u>plan</u> *	Farley* barley parley <u>Harley</u>	cloth* fall flog <u>flaw</u>
7	passing after* apple <u>acid</u>	foundry <u>founder</u> * bounder <u>flounder</u>	crawled craw frog <u>crawl</u>
8	content contest contact <u>convent</u>	Dick dig <u>gig</u> big*	rapid rattle wrapper <u>grapple</u>
9	cause poise pause* <u>car</u>	atom abbot habit <u>avid</u> *	toward torn tore <u>board</u>

Speaker 17 is			
1	lurch work lurk <u>aleit</u>	face* baker basic <u>basis</u>	shuffle shudder* <u>shutter</u> shuttle
2	sought* sock sun <u>stop</u>	muster rustie rusty* <u>rustle</u>	hard card <u>tarred</u> * car
3	only olden older* <u>golden</u>	horn corn form* <u>thorn</u>	fru* root <u>brute</u> group
4	island highland pilot <u>pylon</u> *	flange plan clam <u>planned</u>	shelf shout shelve <u>shell</u>
5	bondage abandon bandit <u>bandits</u> *	ten* pen <u>pin</u> pinned	blimp blink <u>bleak</u> link
6	cat hat cap* <u>catch</u>	line* lying flying <u>lion</u>	theft heck peck <u>pet</u> *
7	rim brim grin <u>grin</u> *	gobble goblet goggle <u>gobbled</u>	gleft theft* crept <u>slept</u>
8	bed did* dead <u>bid</u>	spill still spilled* <u>full</u>	counting* bounty country <u>county</u>
9	mail maiden neighbor <u>maybe</u> *	earl pearl burrow* <u>girl</u>	horn torn thorn* <u>corn</u>

Speaker 18 is			
1	summer summon <u>summit</u>	man mass <u>mas</u> k	bun fun <u>fund</u>
2	lighter* spider fighter <u>piker</u>	roller rolling roll <u>roar</u> *	none mountain <u>now</u> <u>numb</u>
3	verbal bubble gurgle <u>purple</u>	breeze* greed breathe <u>grieve</u>	eat heat feet <u>peak</u>
4	fried try <u>tribe</u> * <u>tried</u>	plus flood bust <u>pluck</u>	child childish <u>childless</u> <u>childhood</u>
5	we read weed <u>weave</u>	retold refold <u>threefold</u> repose*	guess guest gas <u>get</u>
6	sofa soap silver <u>sober</u> *	hate cape* <u>cake</u> case	best bet desk <u>theft</u>
7	lung* love drunk <u>lump</u>	hurt turn turk <u>Turk</u> *	pardon* hardly harden <u>hard</u>
8	shilling chilling chilly <u>killing</u>	falcon* pulpit culprit <u>poker</u>	mark mock lock <u>mop</u>
9	gag gad gas <u>gab</u>	nap nest mess <u>net</u> *	allow aloft lock <u>allot</u> *

EXHIBIT 6 (Continued)

Speaker 19 is		
1	easy	wolf
2	fleecy	wolves*
3	sleepy	chaff
4	fuel	chat
5	yule	chap*
6	saw	check
7	inule	hem
8	field	hemp
9	deal	pen*
10	heel*	hemmed
11	feel	woodland curse
12	farm	wooden hearse
13	harm	wouldn't purse
14	pawn	woodman perch
15	arm*	tighten
16	mouthful	heel
17	mirthful	feel
18	My ^r e	yield*
19	me ^r iful	eel
20	come*	tight*
21	shaky	palm
22	shady	calm
23	shade	lift*
24	shaving*	lit
25	raw	face
26	drawl	fate
27	brawl	faith*
28	draw*	base
29	hairy	buy
30	fairy	bought
31	carriage	box
32	carry*	fought*
33	sue	enjoying*
34	suit	enjoin
35	soon	enjoyment
36	soothe	enjoying*
37	whence	enjoy
38	glimpse	paid
39	bliss	hey*
40	blimp*	pay
41	sue	key
42	suit	whene
43	soon	sweep*
44	soothe	sweetened

Speaker 20 is		
1	scout	weed*
2	spouse	weave
3	hout*	reed
4	spout	leave
5	reedy	put*
6	meeting	foot
7	easy	book
8	need*	cook
9	pick	snuck
10	detect	snub*
11	depict	snow
12	eclipse	snuff
13	fold*	logic*
14	cold	logging
15	hold	lodging
16	hole	Roger
17	brazen	brought
18	break	broad
19	great	dron
20	raisin*	drought*
21	hot	course
22	not*	force
23	pot	horse
24	plot	forest*
25	mission*	troll
26	vision	toll*
27	fisher	told
28	bishop	crawl
29	soft	barre*
30	sought	bear
31	sauce	bearer
32	saw*	barrel
33	fill	defile
34	built	file
35	guild*	defy*
36	bill	devise
37	right	lay*
38	brighten	blade
39	frighten*	glaze
40	bright	glaze
41	worn	lift
42	one*	lick
43	wand	lit*
44	blend	lip
45	gross	smile
46	growth	smart
47	group	smock
48	broke*	mock*
49	blast*	village
50	glad	visit*
51	glass	busy
52	black	vivid
53	room	gold
54	playmate	joom*
55	plainly*	move
56	plainness	moon
57	lion	bit
58	why	fit*
59	wind*	disc
60	wine	dip
61	flood	press
62	luck	crept
63	blunt*	crest*
64	bluff	pressed
65	bend*	resort*
66	gem	export
67	dum	absorb
68	den	exhort
69	lesson	bud*
70	glisten*	bug
71	blessing	bug
72	blessed	budge
73	right	chat
74	brighten	chap*
75	frighten*	check
76	bright	hem
77	act	hemp
78	hat	pen*
79	ax*	hemmed
80	might	woodland curse
81	nice	wooden hearse
82	knife*	wouldn't purse
83	night	woodman perch
84	bless	tighten
85	out	heel
86	house*	feel
87	bounce	yield*
88	omen	type*
89	commit*	tight*
90	commencement	title
91	permit	titillate
92	tiny	titillate
93	Kindly	titillate
94	hang	titillate
95	timing*	titillate
96	purpose	string*
97	propose	strength
98	oppose	strain
99	suppose*	strange
100	frighten	guise
101	brightness	guide
102	greatness	dies
103	blunt*	breakfast
104	bluff	dive*
105	bland	hem*
106	land*	hand
107	plan	end
108	zland	hen
109	flack*	gave*
110	flat	gain
111	black	gave
112	blast	gay
113	ask	clean
114	act	please
115	hat	plead*
116	ax*	lea
117	able	naive*
118	table	name
119	fable*	maid
120	cable	nave
121	doomed*	string*
122	dune	strain
123	doom	strange
124	court	drain
125	courts*	drain
126	corpse	drain
127	torch	rest
128	wreck	rest
129	wrench	rest
130	wretch	rest
131	rest	rest

Speaker 21 is		
1	far*	want
2	barn	one
3	farm	wanton
4	arm	wanted*
5	ungtainted	wasp
6	insane	watch
7	unseen	lost
8	unstain*	what*
9	vowel	hammer
10	bow	hemlock*
11	vow	cannon
12	vow *	hammock
13	valve	elves
14	spouse	cost
15	astound	cross
16	espouse	frost*
17	espoused*	fraud
18	tongue	tall
19	hung	called
20	hum	call*
21	ten*	solve
22	wet	time
23	west	ton
24	wept	come*
25	weapon	tongue
26	author	vest
27	offer	best*
28	often*	theft
29	office	desk
30	prune	mouth*
31	crude	month
32	true	mumps
33	prove*	monk
34	fuse	pity
35	feud	feud
36	hue	city
37	few*	tippy
38	soe	fitting*
39	say	sage*
40	sage	sage*

Speaker 22 is		
1	jig	right
2	gate	brighten
3	dig*	frighten*
4	gig	bright
5	safer	worn
6	savor	one*
7	favor	wand
8	saber	blend
9	decay	gross
10	debate	growth
11	efface	group
12	deface	broke*
13	wool	blast*
14	woe	glad
15	wave*	glass
16	low	black
17	plain	room
18	playmate	joom*
19	plainly*	move
20	plainness	moon
21	rigid	lion
22	bridges*	why
23	frigid	wind*
24	tribute	wine
25	mortar	flood
26	arable*	luck
27	mortal	blunt*
28	morbid	bluff
29	does	bend*
30	bud*	gem
31	buzz	dum
32	bug	den
33	lesson	bud*
34	glisten*	bug
35	blessing	bug
36	blessed	budge
37	right	right
38	brighten	brighten
39	frighten*	frighten*
40	bright	bright
41	act	act
42	hat	hat
43	ax*	ax*
44	might	might
45	nice	nice
46	knife*	knife*
47	night	night
48	bounce	bounce
49	bless	bless
50	out	less*
51	house*	less*
52	bounce	bled
53	omen	blessed
54	commit*	blessed
55	commencement	blow*
56	permit	glow
57	tiny	flow
58	Kindly	slow
59	hang	slow
60	timing*	slow
61	purpose	string*
62	propose	strength
63	oppose	strain
64	suppose*	strange
65	frighten	guise
66	brightness	guide
67	greatness	dies
68	blunt*	breakfast
69	bluff	dive*
70	bland	hem*
71	land*	hand
72	plan	end
73	zland	hen
74	flack*	gave*
75	flat	gain
76	black	gave
77	blast	gay
78	right	clean
79	brighten	please
80	frighten*	plead*
81	bright	lea
82	act	naive*
83	hat	name
84	ax*	maid
85	might	nave
86	nice	string*
87	knife*	strain
88	night	strange
89	bounce	drain
90	bounce	drain
91	omen	drain
92	commit*	drain
93	commencement	drain
94	permit	drain
95	tiny	drain
96	Kindly	drain
97	hang	drain
98	timing*	drain
99	purpose	drain
100	propose	drain
101	oppose	drain
102	suppose*	drain
103	frighten	drain
104	brightness	drain
105	greatness	drain
106	blunt*	drain
107	bluff	drain
108	bland	drain
109	land*	drain
110	plan	drain
111	zland	drain
112	flack*	drain
113	flat	drain
114	black	drain
115	blast	drain
116	right	drain
117	brighten	drain
118	frighten*	drain
119	bright	drain
120	act	drain
121	hat	drain
122	ax*	drain
123	might	drain
124	nice	drain
125	knife*	drain
126	night	drain
127	bounce	drain
128	omen	drain
129	commit*	drain
130	commencement	drain
131	permit	drain
132	tiny	drain
133	Kindly	drain
134	hang	drain
135	timing*	drain
136	purpose	drain
137	propose	drain
138	oppose	drain
139	suppose*	drain
140	frighten	drain
141	brightness	drain
142	greatness	drain
143	blunt*	drain
144	bluff	drain
145	bland	drain
146	land*	drain
147	plan	drain
148	zland	drain
149	flack*	drain
150	flat	drain
151	black	drain
152	blast	drain
153	right	drain
154	brighten	drain
155	frighten*	drain
156	bright	drain
157	act	drain
158	hat	drain
159	ax*	drain
160	might	drain
161	nice	drain
162	knife*	drain
163	night	drain
164	bounce	drain
165	omen	drain
166	commit*	drain
167	commencement	drain
168	permit	drain
169	tiny	drain
170	Kindly	drain
171	hang	drain
172	timing*	drain
173	purpose	drain
174	propose	drain
175	oppose	drain
176	suppose*	drain
177	frighten	drain
178	brightness	drain
179	greatness	drain
180	blunt*	drain
181	bluff	drain
182	bland	drain
183	land*	drain
184	plan	drain
185	zland	drain
186	flack*	drain
187	flat	drain
188	black	drain
189	blast	drain
190	right	drain
191	brighten	drain
192	frighten*	drain
193	bright	drain
194	act	drain
195	hat	drain
196	ax*	drain
197	might	drain
198	nice	drain
199	knife*	drain
200	night	drain
201	bounce	drain
202	omen	drain
203	commit*	drain
204	commencement	drain
205	permit	drain
206	tiny	drain
207	Kindly	drain
208	hang	drain
209	timing*	drain
210	purpose	drain
211	propose	drain
212	oppose	drain
213	suppose*	drain
214	frighten	drain
215	brightness	drain
21		

EXHIBIT 7: FAIRBANKS' RHYME TEST (FIVE SETS OF 50 RHYMING WORDS).

1. BACK	51. FED	101. LAW	151. PAST	201. SOD
2. BALE	52. FEEL	102. LED	152. PAW	202. SOIL
3. BANG	53. FELL	103. LEND	153. PAY	203. SOLD
4. BARK	54. FIG	104. LET	154. PEEL	204. SOON
5. BEAT	55. FIGHT	105. LICK	155. PEN	205. SORE
6. BED	56. FILE	106. LIGHT	156. PICK	206. SUCK
7. BELL	57. FILL	107. LINK	157. PIG	207. SUN
8. BEND	58. FINE	108. LINE	158. PILE	208. TAIL
9. BENT	59. FIRE	109. LIP	159. PIN	209. TAKE
10. BEST	60. FIT	110. LOCK	160. PINK	210. TALE
11. BID	61. FOIL	111. LOOK	161. POP	211. TELL
12. BIG	62. FUN	112. LOT	162. POT	212. TEN
13. BILL	63. GAIN	113. LUCK	163. PUMP	213. TEND
14. BIT	64. GAME	114. LUMP	164. RAGE	214. TENT
15. BOIL	65. GANG	115. MAIL	165. RAIN	215. TEST
16. BOOK	66. GATE	116. MAIN	166. RANG	216. TICK
17. BOON	67. GET	117. MAKE	167. RATE	217. TIDE
18. BORE	68. GOD	118. MALE	168. RAW	218. TILE
19. BORN	69. GOLD	119. MARK	169. RED	219. TILL
20. BUCK	70. GOT	120. MAST	170. REEL	220. TIN
21. BUMP	71. GUN	121. MAY	171. RENT	221. TIP
22. BUST	72. HANG	122. MEAL	172. REST	222. TIRE
23. CAGE	73. HATE	123. MEAT	173. RID	223. TOIL
24. CAKE	74. HEAL	124. MEN	174. RIDE	224. TOLD
25. CAME	75. HEAT	125. MEND	175. RIGHT	225. TOOK
26. CAST	76. HEEL	126. MET	176. RIP	226. TOP
27. COCK	77. HEN	127. MIGHT	177. ROCK	227. TORE
28. COD	78. HID	128. MILE	178. ROD	228. TORN
29. COIL	79. HIDE	129. MINK	179. RUN	229. TUCK
30. COLD	80. HIP	130. MINE	180. RUST	230. VAIN
31. COOK	81. HIRE	131. MOCK	181. SACK	231. VILE
32. COON	82. HIT	132. MOON	182. SAGE	232. WAGE
33. COP	83. HOLD	133. MOP	183. SAIL	233. WAKE
34. CORN	84. HOOK	134. MORE	184. SALE	234. WAY
35. DARK	85. HOP	135. MUST	185. SAME	235. WED
36. DATE	86. HORN	136. NAIL	186. SANG	236. WELL
37. DAY	87. HOT	137. NAME	187. SAW	237. WENT
38. DEAL	88. JACK	138. NEAT	188. SAY	238. WEST
39. DEN	89. JAW	139. NEST	189. SEAL	239. WIDE
40. DID	90. JUMP	140. NIGHT	190. SEAT	240. WIG
41. DIG	91. JUST	141. NANE	191. SELL	241. WILL
42. DIN	92. KEEL	142. NOD	192. SEND	242. WIN
43. DIP	93. KICK	143. NOON	193. SENT	243. WINK
44. DOCK	94. KID	144. NOT	194. SET	244. WINE
45. DUCK	95. KILL	145. NUN	195. SICK	245. WIRE
46. DUMP	96. LACK	146. PACK	196. SIDE	246. WIT
47. DUST	97. LAKE	147. PAGE	197. SIN	247. WORE
48. FAIL	98. LARK	148. PAIN	198. SINK	248. WORN
49. FAME	99. LAST	149. PALE	199. SIRE	249. YET
50. FAST	100. LATE	150. PARK	200. SIT	250. ZEAL

**EXHIBIT 8: FAIRBANKS' RHYME TEST ANSWER SHEET
AND RANDOMIZATION OF INITIAL CONSONANTS
FOR EACH OF THE FIVE LISTS**

NAME:			
DATE:			
TEST No. _____			
1. ____ ot	h,g,n,p,l	26. ____ ast	c,p,f,l,m
2. ____ ay	p,m,d,w,s	27. ____ ain	g,p,m,r,v
3. ____ op	t,h,p,m,c	28. ____ est	n,w,t,b,r
4. ____ eel	p,r,f,h,k	29. ____ un	g,n,r,s,f
5. ____ ake	w,t,m,c,l	30. ____ eal	h,d,s,z,m
6. ____ aw	l,s,j,p,r	31. ____ in	s,w,t,d,p
7. ____ ile	v,m,f,t,p	32. ____ ust	b,j,m,r,d
8. ____ eat	n,s,b,h,m	33. ____ ine	f,m,w,n,l
9. ____ ook	l,c,h,t,b	34. ____ ink	m,l,p,w,s
10. ____ ill	f,k,w,t,b	35. ____ old	s,t,h,c,g
11. ____ ire	t,h,s,f,w	36. ____ it	h,s,w,f,b
12. ____ ale	m,t,s,p,b	37. ____ ed	l,b,r,w,f
13. ____ ent	s,r,w,b,t	38. ____ end	t,s,b,l,m
14. ____ oon	m,n,c,b,s	39. ____ id	r,b,k,d,h
15. ____ ick	k,s,l,t,p	40. ____ ack	b,l,p,j,s
16. ____ ame	s,f,n,c,g	41. ____ ail	t,s,m,n,f
17. ____ ide	w,t,s,r,h	42. ____ ight	f,l,r,m,n
18. ____ ip	r,d,l,h,t	43. ____ orn	t,w,b,h,c
19. ____ ore	s,b,t,m,w	44. ____ od	r,g,c,s,n
20. ____ ang	b,h,s,g,r	45. ____ ock	d,m,c,l,r
21. ____ on	m,d,h,p,t	46. ____ ump	b,p,l,d,j
22. ____ ark	p,b,l,m,d	47. ____ ate	d,r,g,l,h
23. ____ oil	c,f,b,s,t	48. ____ ell	w,f,t,b,s
24. ____ ig	b,w,d,f,p	49. ____ et	s,l,g,y,m
25. ____ age	r,c,p,s,w	50. ____ uck	l,t,d,s,b

correct word, but the number of possible words can range as high as nine. For example, although only got, hot, lot, not, and pot are actually used, a listener might think of jot, rot, sot, or tot. This test was used extensively at the Naval Electronics Laboratory Center in studies of the speech interfering effects of navy noises; see Webster and Klumpp (1965).

A criticism of the Fairbanks Rhyme Test is that it tests initial consonants only (and the response set varies from five to nine). House et al (1965) and Kreul et al (1968) took care of both of these flaws by making a six-alternative-answer sheet foil and testing for initial and final consonants, see exhibits 9 and 10.

The Kreul et al (1968) tests are easy to administer, require no training, and are relatively fast to complete—about 90 seconds for 50 words, since only a 1 $\frac{1}{2}$ -second interval is required between words. The Kreul is the preferred test at NELC now. The word score equivalency between it, the Fairbanks test, and PB words can be found in figure 12, Webster and Allen (1972), simplified and reproduced as figure 2.

EXHIBIT 9: KREUL ET AL AND HOUSE ET AL MODIFIED RHYME TESTS (MRT)
(SIX SETS OF 50 RHYMING WORDS).

1. BACK	61. DULL(-)	118. LANE	176. POT	233. SUB
2. BAD	62. DUM —(DUNG)	119. LARK	177. PUB —(PUCK)	234. SUD 235. SUM
3. BALE	63. DUST	120. LATE	178. PUFF	236.(2)SUN
4. BAN	64. EEL	121. LAW	179. PUG(-)	237. SUNG
5. BANG	65. FAME	122. LAY	180. PUN	238. SUP
6. BARK	66. FANG	123. LED	181. PUP	239. TAB
7. BASS	67. FEAT	124. LICK	182. —(PUS)	240. TACK
8. BAT	68. FED	125. LIP	183. PUTT(-)	241. TALE
9. BATH	69. FEEL	126. LOOK	184. RACE	242. TAM
10. BEACH	70. FIB	127. LOT	185. RAKE	243. TAME
11. BEAD	71.(2)FIG	128. MAD	186. RANG	244. TAN
12. BEAK	72.(2)FILL	129. MALE	187. RATE	245. TANG
13. BEAM	73.(2)FIN	130. MAN	188. RAVE	246. TAP
14. BEAN	74.(2)FIT	131. MAP	189. RAW	247. TEACH
15.(2)BEAT	75. FIZZ	132. MARK	190. RAZE	248. TEAK
16. BED	76. FOIL	133. MASS	191. RED	249. TEAM
17. BENT	77. FOLD	134. MAT	192. REEL	250. TEAR
18. BEST	78. FUN	135. MATH	193. RENT	251. TEASE
19. BIG	79. GALE	136. MAY	194. REST	252. TEN
20. BILL	80. GAME	137. MEAT	195. RIG	253. TENT
21. BIT	81. GANG	138. MEN	196. RIP	254. TEST
22. BOIL	82. GAY	139. MOP	197. RUN	255. THAW
23. BOOK	83. GOLD	140. MUST	198. RUST	256. THEN
24. BUCK	84. GOT	141. NAME	199. SACK	257. TICK
25. BUFF	85. GUN	142. NEAT	200. SAD	258. TILL
26. BUG	86. GUST	143. NEST	201. SAFE	259. TIN
27.(2)BUN	87. HANG	144. NOT	202. SAG	260. TIP
28. BUS	88. HARK	145. NUN	203. SAKE	261. TOIL
29. BUST	89. HEAL	146. OIL	204.(2)SALE	262. TOLD
30. BUT	90. HEAP	147. PACE	205.(2)SAME	263. TOOK
31. CAKE	91. HEAR	148. PAD	206. SANE	264. TOP
32.(2)CAKE	92.(2)HEAT	149. PAGE	207. SANG	265. TOT
33. CANE	93. HEATH	150.(2)PALE	208. SAP	266. VEST
34. CAPE	94. HEAVE	151. PAN	209. SASS	267. WAY
35. CASE	95. HEEL	152. PANG(-)	210. SAT	268. WED
36. CAVE	96. HEN	153. PANE	211. SAVE	269. WENT
37. COIL	97. HILL	154. PARK	212. SAW	270. WEST
38. COLD	98. HIP	155. PASS	213. SAY	271. WICK
39. COOK	99. HIT	156. PAT	214. SEAT	272. WIG
40. COP	100. HOLD	157. PATH	215. SEED	273. WILL
41. CUB	101. HOOK	158. PAVE	216. SEEK	274. WIN
42. CUD	102. HOP	159. PAW	217. SEEM	275. WIT
43. CUFF	103. HOT	160.(2)PAY	218. SEEN	
44. CUP	104. JAW	161. PEACE	219. SEEP	
45. CUSS	105. JIG(-)	162. PEACH	220. SEETHE	
46. CUT	106. JUST	163. PEAK	221. SENT	
47. DARK	107. KEEL	164. PEAL	222. SHED	
48. DAY	108. KICK(KICK)(2)	165. PEAS	223. SHOOK	
49. DEN	109. KID	166. PEAT	224. SHOP	
50. DENT	110.(2)KILL	167. PEEL	225.(2)SICK	
51. DID	—(KIN)	168. PEN	226. SILL	
52. DIG(DIG)(2)	111. KING	169.(2)PICK	227.(2)SIN	
53. DILL	112. KISS(-)	170.(2)PIG	228. SING	
54. DIM	113.(2)KIT	171. PILL	229.(2)SIP	
55.(2)DIN	114. KITH(-)	172.(2)PIN	230.(2)SIT	
56.(2)DIP	115. LACE	173. PIP	231. SOIL	
57. DUB	116. LAKE	174. PIT	232. SOLD	
58. DUCK	117. LAME	175. POP		
59. DUD				
60. DUG				

Notes. The numeral 2 in parentheses signifies that the word is used twice in the test.

The words in parentheses are those used by House et al and not by Kreul et al.

EXHIBIT 10: KREUL ET AL MODIFIED RHYME TEST ANSWER SHEETS.

NAME _____	EAR _____	DATE _____		
MODIFIED RHYME HEARING TEST 1				
LIST _____				
<div style="border: 1px solid black; padding: 5px; margin-bottom: 5px;">1. 1. sing 2. sit 3. sin 6. sill 4. sip 5. sick</div> <div style="border: 1px solid black; padding: 5px; margin-bottom: 5px;">6. 3. fin 2. fig 6. fit 5. fib 1. fill 4. fizz</div> <div style="border: 1px solid black; padding: 5px; margin-bottom: 5px;">11. 2. bit 6. hit 4. sit 6. wit 3. fit 1. kit</div> <div style="border: 1px solid black; padding: 5px; margin-bottom: 5px;">16. 1. raw 6. saw 2. paw 5. thaw 4. jaw 3. law</div> <div style="border: 1px solid black; padding: 5px; margin-bottom: 5px;">21. 2. rake 1. rave 6. ray 5. raze 4. rate 3. race</div> <div style="border: 1px solid black; padding: 5px; margin-bottom: 5px;">26. 2. heath 5. heat 4. heave 1. hear 3. heal 6. heap</div> <div style="border: 1px solid black; padding: 5px; margin-bottom: 5px;">31. 1. peace 3. peak 6. peach 5. peat 4. peal 2. peas</div> <div style="border: 1px solid black; padding: 5px; margin-bottom: 5px;">36. 2. dip 6. din 4. dim 3. did 1. dig 5. dill</div> <div style="border: 1px solid black; padding: 5px; margin-bottom: 5px;">41. 5. mop 6. shop 1. top 2. hop 4. cop 3. pop</div> <div style="border: 1px solid black; padding: 5px; margin-bottom: 5px;">46. 5. park 2. dark 3. mark 6. bark 4. lark 1. hark</div>	<div style="border: 1px solid black; padding: 5px; margin-bottom: 5px;">2. 6. look 3. shook 4. cook 2. took 5. hook 1. book</div> <div style="border: 1px solid black; padding: 5px; margin-bottom: 5px;">7. 5. toil 3. boil 1. foil 6. soil 2. coil 4. oil</div> <div style="border: 1px solid black; padding: 5px; margin-bottom: 5px;">12. 1. came 2. cape 3. cane 4. cake 5. cave 6. case</div> <div style="border: 1px solid black; padding: 5px; margin-bottom: 5px;">17. 5. rent 3. went 1. dent 6. sent 4. tent 2. bent</div> <div style="border: 1px solid black; padding: 5px; margin-bottom: 5px;">22. 6. bill 2. hill 5. fili 1. will 3. kill 4. till</div> <div style="border: 1px solid black; padding: 5px; margin-bottom: 5px;">27. 3. sag 4. sack 6. sat 2. sass 5. sap 1. sad</div> <div style="border: 1px solid black; padding: 5px; margin-bottom: 5px;">32. 6. pay 1. way 4. gay 2. may 3. say 5. day</div> <div style="border: 1px solid black; padding: 5px; margin-bottom: 5px;">37. 5. ceam 6. teak 3. tease 2. tear 1. teach 4. teal</div> <div style="border: 1px solid black; padding: 5px; margin-bottom: 5px;">42. 5. lane 6. lame 4. lace 3. lay 2. lake 1. late</div> <div style="border: 1px solid black; padding: 5px; margin-bottom: 5px;">47. 1. p'n 5. din 2. sin 3. tin 6. fin 4. win</div>	<div style="border: 1px solid black; padding: 5px; margin-bottom: 5px;">3. 2. vest 6. rest 1. nest 4. test 5. best 3. west</div> <div style="border: 1px solid black; padding: 5px; margin-bottom: 5px;">8. 3. rust 4. must 2. just 5. gust 6. dust 1. bust</div> <div style="border: 1px solid black; padding: 5px; margin-bottom: 5px;">13. 3. hold 6. cold 4. fold 5. gold 2. told 1. sold</div> <div style="border: 1px solid black; padding: 5px; margin-bottom: 5px;">18. 3. pace 5. pale 1. page 4. pay 6. pave 2. pane</div> <div style="border: 1px solid black; padding: 5px; margin-bottom: 5px;">23. 6. pan 3. pang 4. pad 1. pass 2. pat 5. path</div> <div style="border: 1px solid black; padding: 5px; margin-bottom: 5px;">28. 3. gun 2. nun 6. run 1. sun 5. bun 4. fun</div> <div style="border: 1px solid black; padding: 5px; margin-bottom: 5px;">33. 3. den 2. pen 4. hen 6. men 1. ten 5. then</div> <div style="border: 1px solid black; padding: 5px; margin-bottom: 5px;">38. 3. sub 4. sun 6. sung 5. sup 1. sud 2. sum</div> <div style="border: 1px solid black; padding: 5px; margin-bottom: 5px;">43. 2. beach 3. beat 1. bean 6. beak 5. bead 4. beam</div> <div style="border: 1px solid black; padding: 5px; margin-bottom: 5px;">48. 1. tab 4. tang 2. tan 3. tam 5. tuck 6. tap</div>	<div style="border: 1px solid black; padding: 5px; margin-bottom: 5px;">4. 6. kill 3. kid 4. kit 2. king 1. kith 5. kiss</div> <div style="border: 1px solid black; padding: 5px; margin-bottom: 5px;">9. 4. rig 5. pig 2. wig 3. big 1. jig 6. fig</div> <div style="border: 1px solid black; padding: 5px; margin-bottom: 5px;">14. 5. mass 1. map 3. math 4. man 6. mad 2. mat</div> <div style="border: 1px solid black; padding: 5px; margin-bottom: 5px;">19. 3. came 6. game 4. name 1. fame 2. same 5. tame</div> <div style="border: 1px solid black; padding: 5px; margin-bottom: 5px;">24. 5. keel 1. peel 2. reel 6. eel 3. fee! 4. heel</div> <div style="border: 1px solid black; padding: 5px; margin-bottom: 5px;">29. 6. tick 4. pick 3. sick 5. wick 2. lick 1. kick</div> <div style="border: 1px solid black; padding: 5px; margin-bottom: 5px;">34. 4. seat 5. beat 1. meat 3. heat 2. feat 6. neat</div> <div style="border: 1px solid black; padding: 5px; margin-bottom: 5px;">39. 4. pig 1. pill 5. pin 2. pick 3. pip 6. pit</div> <div style="border: 1px solid black; padding: 5px; margin-bottom: 5px;">44. 5. sang 6. hang 3. gang 4. bang 1. rang 2. fang</div> <div style="border: 1px solid black; padding: 5px; margin-bottom: 5px;">49. 6. bath 3. back 1. bat 5. ban 4. bass 2. bad</div>	<div style="border: 1px solid black; padding: 5px; margin-bottom: 5px;">5. 5. putt 2. puff 6. pub 1. pun 3. pup 4. pug</div> <div style="border: 1px solid black; padding: 5px; margin-bottom: 5px;">10. 4. sane 3. save 5. safe 6. same 2. sale 1. sake</div> <div style="border: 1px solid black; padding: 5px; margin-bottom: 5px;">15. 5. sale 6. pale 1. gale 4. bale 2. male 3. tale</div> <div style="border: 1px solid black; padding: 5px; margin-bottom: 5px;">20. 4. dub 3. du.l 6. dun 1. duck 2. dud 5. dug</div> <div style="border: 1px solid black; padding: 5px; margin-bottom: 5px;">25. 2. bus 1. bun 4. buff 5. buck 6. bug 3. but</div> <div style="border: 1px solid black; padding: 5px; margin-bottom: 5px;">30. 3. cuff 4. cup 5. cud 2. cub 6. cuss 1. cut</div> <div style="border: 1px solid black; padding: 5px; margin-bottom: 5px;">35. 4. dip 5. hip 2. rip 1. sip 6. lip 3. tip</div> <div style="border: 1px solid black; padding: 5px; margin-bottom: 5px;">40. 5. fed 3. red 2. shed 6. wed 4. bed 1. led</div> <div style="border: 1px solid black; padding: 5px; margin-bottom: 5px;">45. 1. seep 4. seed 5. seem 3. seethe 2. seen 6. seek</div> <div style="border: 1px solid black; padding: 5px; margin-bottom: 5px;">50. 1. hot 3. not 6. tot 2. got 5. lot 4. pot</div>

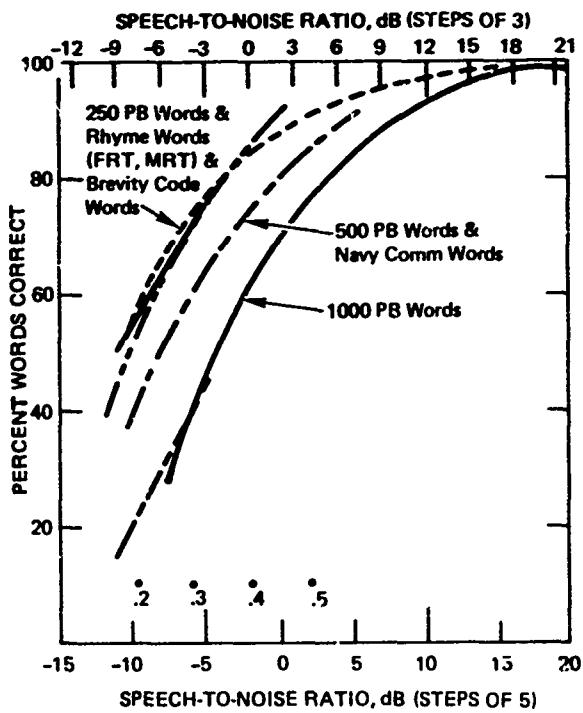


Figure 2. PB, rhyme, brevity code, and Navy communication word intelligibility as a function of speech-to-noise ratio and AI.

NUMBER OF SYLLABLES

Another factor affecting speech intelligibility scores is the number of syllables in a word. Bisyllabic words with equal stress on each syllable (railroad, birthday, etc.), called spondees, or spondaic words, have long been used clinically for determining degree of deafness and evaluating hearing aids. However, since this document is intended to be a handbook of speech tests for evaluating equipment, only passing mention is made of tests used primarily in a speech and hearing clinic.

An early and much-used spondee test was developed as Psycho-Acoustic Laboratory (PAL) Auditory Test 9; see Hudgins, Hawkins, Karlin, and Stevens (1947) and for later modification, Hirsh et al (1952). The Hirsh list is shown in exhibit 11. Spondaic words are the easiest of word tests and, if used in equipment evaluation, should be used primarily for setting voice levels, since the equally stressed syllables make it easy to monitor VU or other sound level meters.

EXHIBIT 11: HIRSH SPONDEES.

SPONDAIC WORDS OF CID AUDITORY TESTS W-1 AND W-2

1. airplane	10. eardrum	19. iceberg	28. railroad
2. armchair	11. farewell	20. inkwell	29. schoolboy
3. baseball	12. grandson	21. mousetrap	30. sidewalk
4. birthday	13. greyhound	22. mushroom	31. stairway
5. cowboy	14. hardware	23. northwest	32. sunset
6. daybreak	15. headlight	24. oatmeal	33. toothbrush
7. doormat	16. horseshoe	25. padlock	34. whitewash
8. drawbridge	17. hotdog	26. pancake	35. woodwork
9. duckpond	18. hothouse	27. playground	36. workshop

PHONETIC ELEMENTS

It has been well established in the experimental literature that vowels have greater sound pressure levels than consonants and that certain vowels – and consonants – are higher in basic vocalic level than others. Since vowels tend to be heard better under adverse conditions than consonants, it is confusion among consonants that causes confusion among words. Therefore, the statement is often made that consonants determine word intelligibility. From the beginning, attempts have been made to balance word lists with phonetic elements in the same proportion that occurs in "everyday" English. However, in many instances, especially in systems involving extensive speech processing, it is important to determine exactly which phonetic elements are intelligible and which are not.

All the rhyme tests so far discussed (Fairbanks, Kreul et al, House et al) have been consonant tests. Vowel rhyme tests are not so numerous but at least one has been developed for potential armed service use. The words of Clarke's (1965) phonetically balanced rhyme test for vowels (medial position between two consonants) are listed in exhibit 12. A typical answer sheet is shown in exhibit 13, and the phonetic structure of the test in exhibit 14.

Phonetic (consonant) analyses of the Fairbanks (1958) test and of the Modified Rhyme Tests are shown in exhibits 15 and 16. Tables 14-16 are shown as aids to anyone who really needs this depth of analysis in using the word tests.

A special test has been developed, with computerized scoring, to test diagnostically for phonetic confusion. Exhibit 17 lists the word (or syllable) pairs of Voiers's (1967, 1971) Diagnostic Rhyme Test (DRT) and exhibit 18 shows the phonetic composition of the DRT. Use of the DRT is suggested for detailed testing in the development phases of vocoders or complex speech processing systems. The listener is forced to respond to one of two fixed and known foils.

EXHIBIT 12: CLARKE'S PBRT(V) WORD LIST.

1. AT	51. FATE	101. LET	151. PEA	201. SLIGHT
2. BAD	52. FEAR	102. LICK	152. PEER	202. SLIT
3. BAIL	53. FELL	103. LID	153. PEN	203. SLOT
4. BAIT	54. FIGHT	104. LIE	154. PEP	204. SOAK
5. BALL	55. FILE	105. LIGHT	155. PET	205. SOCK
6. BAND	56. FILL	106. LIKE	156. PIE	206. SOD
7. BEAD	57. FIT	107. LIMB	157. PILE	207. SON
8. BED	58. FOOT	108. LIME	158. PILL	208. SOON
9. BELL	59. FOR	109. LIST	159. PIN	209. SPAN
10. BEND	60. FOUGHT	110. LIT	160. PIPE	210. SPIN
11. BET	61. FOUL	111. LOAD	161. PIT	211. SPINE
12. BID	62. FUR	112. LOCK	162. POLE	212. SPOON
13. BIND	63. GATE	113. LOOK	163. POOL	213. SPUN
14. BIRD	64. GET	114. LOOM	164. POOR	214. STACK
15. BIT	65. GOAT	115. LOST	165. POP	215. STAKE
16. BOAT	66. GOT	116. LOT	166. POPE	216. STALK
17. BOND	67. GUT	117. LOUD	167. POT	217. STALL
18. BOUND	68. HAD	118. LOW	168. POUR	218. STAR
19. BOUT	69. HAIL	119. MAR	169. POUT	219. STARE
20. BOWL	70. HALL	120. MARE	170. PUP	220. STEER
21. BRAID	71. HAM	121. MAT	171. RAID	221. STICK
22. BREAD	72. HAT	122. MATE	172. RAT	222. STILL
23. BREED	73. HEAD	123. MEET	173. RATE	223. STIR
24. BROAD	74. HEAT	124. MERE	174. RED	224. STOCK
25. BROOD	75. HEED	125. MESS	175. RID	225. STOLE
26. BULL	76. HEM	126. MET	176. RIGHT	226. STOOL
27. CALL	77. HID	127. NIGHT	177. ROAD	227. STORE
28. COAL	78. HILL	128. MISS	178. ROD	228. STYLE
29. CCIL	79. HIM	129. MOOR	179. ROT	229. SUCK
30. COOL	80. HIT	130. MORE	180. RUT	230. SUIT
31. COWL	81. HOLE	131. MOSS	181. SAD	231. TALE
32. DALE	82. HOME	132. MOUSE	182. SAID	232. TALL
33. DAME	83. HOOD	133. MUSS	183. SAKE	233. TAP
34. DAWN	84. HOT	134. NET	184. SANE	234. TAPE
35. DEAN	85. HOWL	135. NIGHT	185. SAT	235. TEA
36. DELL	86. HUM	136. NOT	186. SEAT	236. TELL
37. DEN	87. HURT	137. NOTE	187. SEED	237. TEN
38. DIME	88. IT	138. NUT	188. SET	238. TIE
39. DIN	89. LAID	139. OAT	189. SHEET	239. TILL
40. DOLE	90. LAKE	140. OUT	190. SHIRT	240. TIN
41. DOLL	91. LAMB	141. PA	191. SHOOT	241. TIP
42. DOME	92. LAME	142. PAIN	192. SHOT	242. TO
43. DOOM	93. LAST	143. PAIR	193. SHOUT	243. TOE
44. DOWN	94. LATE	144. PALE	194. SICK	244. TONE
45. DULL	95. LAW	145. PAN	195. SIDE	245. TOOL
46. DUMB	96. LAY	146. PAR	196. SIGN	246. TOP
47. EAT	97. LEAST	147. PAT	197. SIN	247. TOWN
48. FAIL	98. LED	148. PAW	198. SIT	248. TOY
49. FAIR	99. LEE	149. PAWN	199. SLAT	249. TURN
50. FAR	100. LEST	150. PAY	200. SLATE	250. TYPE

EXHIBIT 13: CLARKE'S PBRT(V) ANSWER SHEET.

Name _____	List _____	Equip. _____	Date _____						
Talker _____	Talker's Mic _____	Replication # _____							
1. IT	AT	OAT	EAT	OUT	26. SIN	SON	SIGN	SANE	SOON
2. MISS	MUSS	MESS	MOSS	MOUSE	27. LIT	LET	LIGHT	LOT	LATE
3. BID	BIRD	BED	BAD	BEAD	28. TIP	TYPE	TOP	TAP	TAPE
4. DULL	DELL	DOLL	DALE	DOLE	29. STEER	STIR	STARE	STAR	STORE
5. PUP	PEP	PIPE	POP	POPE	30. TIE	TOE	TEA	TO	TOY
6. SICK	SUCK	SOCK	SAKE	SOAK	31. SIT	SET	SAT	SEAT	SUIT
7. STICK	STALK	STOCK	STACK	STAKE	32. LIE	LAW	LAY	LOW	LEE
8. DIN	DEN	DAWN	DEAN	DOWN	33. BELL	BALL	BAIL	BOWL	BULL
9. BREAD	BROAD	BRAID	BREED	BROOD	34. BIT	BET	BAIT	BOAT	BOUT
10. RID	RED	ROD	RAID	ROAD	35. DUMB	DIME	DAME	DOME	DOOM
11. HIT	HURT	HOT	HAT	HEAT	36. SPIN	SPUN	SPINE	SPAN	SPOON
12. HILL	HALL	HAIL	HOLE	HOWL	37. MET	MIGHT	MAT	MATE	MEET
13. PIT	PET	PAT	POT	POUT	38. RUT	RIGHT	ROT	RAT	RATE
14. FILL	FELL	FILE	FAIL	FOUL	39. TIN	TURN	TEN	TONE	TOWN
15. HIM	HUM	HEM	HAM	HOME	40. GUT	GET	GOT	GATE	GOAT
16. SHIRT	SHOT	SHEET	SHOOT	SHOUT	41. LIST	LEST	LOST	LAST	LEAST
17. FIT	FIGHT	FOUGHT	FATE	FOOT	42. LICK	LIKE	LOCK	LAKE	LOOK
18. LIMB	LIME	LAMB	LAME	LOOM	43. MERE	MARE	MAR	MORE	MOOR
19. PEER	PAIR	PAR	POUR	POOR	44. FEAR	FUR	FAIR	FOR	FAR
20. LED	LED	LAID	LOAD	LOUD	45. TILL	TELL	TALL	TALE	TOOL
21. HID	HEAD	HAD	HEED	HOOD	46. PIN	PEN	PAWN	PAN	PAIN
22. PILL	PILE	PALE	POLE	POOL	47. BEND	BIND	BOND	BAND	BOUND
23. SLIT	SLIGHT	SLOT	SLAT	SLATE	48. STILL	STYLE	STALL	STOLE	STOOL
24. NUT	NET	NIGHT	NOT	NOTE	49. SAID	SIDE	SOD	SAD	SEED
25. CALL	COAL	COOL	COWL	COIL	50. PIE	PAW	PA	PAY	PEA

EXHIBIT 14: CLARKE'S PBRT(V) PHONETIC STRUCTURE.

EXHIBIT 14 (Continued).

Phonetic Symbol	a	u	ɔ	ɛ	i	ɪ	ə	o	ʊ	ɔɪ	uɪ	əʊ
Key Words	bat	cup	bet	pet	set	bet	pet	set	bet	pet	pet	bet
Items	Word Foils											
ALPHA-BETICAL LISTING	RANDOMIZED LISTING											
25.	43)	{m - r}	a							oo		
		{m - re}	o	a	e							
26.	2)	m - s(e)	o	e	i					ou	u	
		{m - ght}	a	e	ee					i		
27.	37)	{m - t}		a								
		{m - te}										
		{n - ght}										
28.	24)	{n - t}	o	e								u
		{n - te}										
29.	50)	p -	a	aw	ay	ə	ie					
30.	22)	{p - le}	a			i		o				
		{p - l(1)}						oo				
31.	46)	p - n	a	aw	ai	e	i					
32.	5)	p - p	o		e							u
		p - pe				i	i	o				
33.	19)	p - r	a	ai		ee		oo		cu		
34.	13)	p - t	ao		e	i				ou		
35.	10)	r - d	o	ai	e	i		oa				
		{r - ght}					i					
36.	38)	{r - t}	ao									u
		{r - te}		a								
37.	6)	{s - ck}	o			i						u
		{s - k(e)}	a									
38.	49)	s - d(e)	ao		ai	ee	i		oa			
		{s - gn}					i					
39.	26)	{s - n}				i		oo		o		
		s - ne		a								
40.	31)	s - t	a		e	ə	i		ui			
41.	16)	sh - t	o		ee			ir	oo	ou		
		{sl - ght}				i						
42.	23)	sl - t	ao			i						
		sl - te		a								
43.	36)	sp - n	a			i		oo		u		
		{sp - ne}				i						

EXHIBIT 14 (Continued).

Phonetic Symbol

Key Word

Items Word Foils

ALPHA-BETICAL LISTING	RANDOMIZED LISTING
-----------------------	--------------------

- | | | |
|-----|-----|---------------|
| | | { st - ck } |
| 44. | 7) | { st - ke } |
| | | { st - lk } |
| 45. | 48) | { st - le } |
| | | { st - l(1) } |
| 46. | 29) | { st - r } |
| | | { st - re } |
| 47. | 30) | t - |
| 48. | 45) | { t - le } |
| | | { t - l(1) } |
| 49. | 39) | { t - n(e) } |
| | | { t - p } |
| | | { t - pe } |

EXHIBIT 15: FAIRBANKS' RHYME TEST PHONETIC STRUCTURE.

No.	Vowels or Diphthongs	Consonants																				
		b	k	c	d	f	g	h	j	dz	k	l	m	n	p	r	s	t	v	w	y	z
1	— ack (ae)	b							j		l				p	s						
2	— age (e)		c												p	r	s		w			
3	— ail (e)					f						m	n			s	t					
4	— ain (e)						g					m		p	r			v				
5	— ake (e)	c									l	m					t		w			
6	— ale (e)	b									m		p		s	t						
7	— ame (e)	c				f	g					n			s							
8	— ang (ae)	b					g	h						r	s							
9	— ark (a)	b	d								l	m		p								
10	— ast (ae)	c		f							l	m	p									
11	— ate (e)	d		g	h						l				r							
12	— aw (ɔ)						j				l		p	r	s							
13	— ay (e)	d									m	p	s			w						
14	— eal (i)	d				h					m			s								z
15	— eat (i)	b				h					m	n		s								
16	— ed (ɛ)	b		f						l				r			w					
17	— eel (i)		f	b					k			p	r									
18	— ell (ɛ)	b	f											s	t	w						
19	— en (ɛ)		d		h						m	p		s	t							
20	— end (ɛ)	b								l	m			s	t							
21	— ent (ɛ)	b											r	s	t	w						
22	— est (ɛ)	b										n	r	t		w						
23	— et (ɛ)				g					l	m			s		y						
24	— ick (ɪ)									k	l		p	s	t							
25	— id (ɪ)	b	d		h				k			r										
26	— ide (aɪ)				h							r	s	t	w							
27	— ig (ɪ)	b	d	f								p				w						
28	— ight (aɪ)		f							l	m	n	r									
29	— ile (aɪ)		f							m	p		t	v								
30	— ill (ɪ)	b	f						k				t		w							
31	— in (ɪ)		d								p		s	t	w							
32	— ink (ɪ)									l	m	p		s		w						
33	— ine (aɪ)		f							l	m	n										
34	— ip (ɪ)	d		h						l		r		t								
35	— ire (aɪ)		f	h								s	t		w							
36	— it (ɪ)	b	f	h								s			w							
37	— ock (a)	c	d							l	m		r									
38	— od (a)	c			g						n		r	s								
39	— oil (ɔɪ)	b	c	f										s	t							
40	— old (ɔ)	c		g	h								s	t								
41	— ook (ʊ)	b	c		h					l												
42	— oon (u)	b	c								m	n		s								
43	— op (a)	c			h						m		p		t							
44	— ore (ɔ)	b									m			s	t	w						
45	— orn (ɔ)	b	c		h									t		w						
46	— ot (a)			g	h					l	n	p										
47	— uck (ʌ)	b	d						j		l			s	t							
48	— ump (ʌ)	b	d						j	l			p									
49	— un (ʌ)			f	g						n		r	s								
50	— ust (ʌ)	b	d			j					m		r									

TOTAL	250	22	12	13	15	9	16	4	4	19	21	10	18	17	27	22	2	17	1	1
		(k)	b	c	d	f	g	h	j	(dz)	k	l	m	n	p	r	s	t	v	w
																			y	z

EXHIBIT 16: KREUL ET AL MODIFIED RHYME TEST PHONETIC STRUCTURE.

No.	Root	V O W E L	Initial Consonant																						
			b	c	ch	d	f	g	h	j	l	m	n	ng	p	r	s	sh	t	th	th	v	w	y	z
1	-ale	e	b					g			m				p	s	t								
2	-ame	e	c				f	g	i			n				s	t								
3	-ang	ae	b				f	g	h							r	s								
4	-ark	a	b			d		h		l	m				p	r	s								
5	-aw	ɔ								l	l				p	r	s		th						
6	-ay	e			d		g				m				p	s						w			
7	-eat	i	b			f		h		m	n					s									
8	-ed	ɛ	b			f				l					r	sh					w				
9	-eel	i	k			f		h							p	r								-	
10	-en	ɛ			d		h			m					p			t	th						
11	-ent	ɛ	b	d											r	s	t			w					
12	-est	ɛ	b								n				r	t			v	w					
13	-ick	I	k		(d)	f			i						p	s	t			w					
14	-ig	I	b		(d)	f									p	r									
15	-ill	I	b	k		f		h									t			w					
16	-in	I			d	f									p	s	t			w					
17	-ip	I			d		h		l						r	s	t								
18	-it	I	b	k		f		h							s					w					
19	-oil	ɔɪ	b	c		f									s	t								-	
20	-old	o	c		f	g	h								s	t									
21	-ook	v	b	c			h		l							sh	t								
22	-op	a	c				h			m					p	sh	t								
23	-ot	a				g	h		l	n					p		t								
24	-un	ʌ	b		f	g		j		m					r	s									
25	-ust	ʌ	b		d	g									r										
TOTAL			14	9	0	7	12	8	12	3	7	7	5	0	11	10	14	3	14	1	1	1	9	2	0

(HOUSE, et al +1 -1)

EXHIBIT 16 (Continued).

		Root	V O W E L	Final Consonant																					
No.				b	c	ch	d	f	g	h	j	l	m	n	ng	p	r	s	sh	t	th	th	v	w	y
26	ba-	ae	k	ck		ts		d					n			ss		s		t	th				
27	bea-	i	k	k	ch	ch	d						m	n			ss		t						
28	bu-	ʌ	ck				ff	g					n			s		t							
29	ca-	e	ke									me	ne		pe	se							ve		
30	cu-	ʌ b				d	ff					p		ss		t									
31	di-	I				d		g		ll	m	n	p												
32	du-	ʌ b	ck		d		g		ll	n	(ng)														
33	fi-	I i					g		ll	n								t					zz		
34	hea-	i							l			p	r			t		th	ve						
35	ki-	I	(ck)	d					ll	(n)	ng		ss		t		th								
36	la-	e	ke						me	ne		ce	te										y		
37	ma-	ae			d				n		p	ss	t		th										
38	pa-	ae	(ck)	d					n	ng		ss	t		th										
39	pa-	e					ge	le	ne			ce				ve	*								
40	pea-	i	k	ch					l			ce	t			ve							s		
41	pi-	I	ck			ff	g		ll	n	p		(s)	tt											
42	pu-	ʌ b	(ck)						n		p														
43	ra-	e	ke									ce	te			ve	y	ze							
44	sa-	ae	ck	d		g					p	ss	t												
45	sa-	e	ke		fe			le	me	ne							ve								
46	see-	i	k	d					m	n	p					the									
47	si-	I	ck					ll	n	ng	p			t											
48	su-	ʌ b		d					m	n	ng	p													
49	ta-	ae b	ck						m	n	ng	p													
50	tea-	i	k	ch					l	m		r											se		
TOTAL				6	15	3	11	4	7	0	1	11	9	18	5	12	2	12	0	16	1	5	5	0	3
GRAND TOTAL				20	24	3	18	16	15	12	4	18	16	23	5	23	12	26	3	30	2	6	6	9	5
(House, et al +3 (+1) -1 (-1) -1 +1 0 0 -1 -1)																									

EXHIBIT 17: VOIERS'S DIAGNOSTIC RHYME TEST.

1. BAD	48. DENSE	94. JEST	140. PEEN	186. TENSE
2. BANK	49. DILD	95. JILT	141. PEG	187. TENT
3. BAT	50. DILL	96. JACK	142. PENCE	188. TEST
4. BEAN	51. DINT	97. JOE	143. PENT	189. THAD
5. BEAT	52. DIP	98. JOT	144. PEST	190. THAN
6. BEE	53. DOCK	99. JUICE	145. POND	191. THANK
7. BEND	54. DOLE	100. KEEP	146. POOH	192. THAW
8. BID	55. DONG	101. KEG	147. POOL	193. THEE
9. BILL	56. DOT	102. KEY	148. POOP	194. THEN
10. BIT	57. DOTE	103. KNOCK	149. POT	195. THICK
11. BOAST	58. DOUGH	104. LAMP	150. RAMP	196. THIN
12. BOB	59. DOZE	105. LAP	151. RAP	197. THING
13. BOOT	60. DUES	106. LAW	152. RAW	198. THONG
14. BOMB	61. DUNE	107. LEAK	153. REAP	199. THOLE
15. BON	62. FAD	108. LEAP	154. REED	200. THOR
16. BOND	63. FAN	109. LEND	155. REEK	201. THOSE
17. BONE	64. FAST	110. LEST	156. REND	202. THOUGH
18. BONG	65. FAULT	111. LEWD	157. REST	203. THOUGHT
19. BOSS	66. FEEL	112. LID	158. RID	204. TICK
20. BOWL	67. FENCE	113. LIP	159. RIP	205. TINT
21. BOX	68. FIN	114. LOAD	160. ROAD	206. TONG
22. CALF	69. FIT	115. LOCK	161. ROCK	207. TOOL
23. CARE	70. FOAL	116. LONG	162. ROD	208. TOOT
24. CAUGHT	71. FOO	117. LOOT	163. ROOT	209. TOT
25. CHAD	72. FOP	118. LOT	164. ROT	210. TUNE
26. CHAIR	73. FORE	119. LOW	165. ROW	211. VAST
27. CHAW	74. FOUGHT	120. MAD	166. RUDE	212. VAULT
28. CHEAT	75. GAB	121. MEAT	167. RUE	213. VEAL
29. CHEEP	76. GAFF	122. MEND	168. SAG	214. VEE
30. CHEW	77. GAT	123. MET	169. SAID	215. VILL
31. CHIN	78. GAUZE	124. MIT	170. SANK	216. VOLE
32. CHOCK	79. GHOST	125. MOAN	171. SAW	217. VON
33. CHOOSE	80. GILL	126. MOM	172. SHAD	218. VOX
34. CHOP	81. GILT	127. MOON	173. SHAG	219. WAD
35. COAT	82. GIN	128. MOOT	174. SHAW	220. WALL
36. COOL	83. GNAW	129. MOSS	175. SHEET	221. WEED
37. COOP	84. GO	130. NAB	176. SHOES	222. WIELD
38. COOT	85. GOAT	131. NECK	177. SHOW	223. WREN
39. COP	86. GOB	132. NEED	178. SING	224. WRONG
40. DAB	87. GOOSE	133. NET	179. SO	225. YAWL
41. DAN	88. GOT (2)	134. NEWS	180. SOLE	226. YEN
42. DANK	89. GUEST	135. NIP	181. SUE	227. YIELD
43. DAUNT	90. HIT	136. NOON	182. TAUGHT	228. YOU
44. DAW	91. HOP	137. NOTE	183. TAUNT	229. ZED
45. DECK	92. JAB	138. PAN	184. TEA	230. ZEE
46. DEED	93. JAWS	139. PEAK	185. TEAK	231. ZOO
47. DEN				

EXHIBIT 17 (Continued).

BOB - GOB	COOT - TOOT
DAUNT - TAUNT	POND - BOND
MOOT - BOOT	BONE - MOAN
SHEET - CHEAT	BILL - VILL
GAB - JAB	GUEST - JEST
TOT - POT	FOUGHT - THOUGHT
BOAST - GHOST	POOP - COOP
RIP - LIP	LEAP - REAP
SAID - ZED	FAST - VAST
GNAW - DAW	KNOCK - DOCK
SHOES - CHOOSE	DOZE - THOSE
KEEP - CHEEP	SING - THING
DANK - BANK	NET - MET
DOT - GOT	CAUGHT - TAUGHT
ROAD - LOAD	LEWD - RUDE
TINT - DINT	BEAN - PEEN
DECK - NECK	MAD - BAD
TONG - THONG	BOX - VOX
CHEW - COO	JOE - GO
REED - WEED	DID - BID
SAG - SHAG	WREN - YEN
LOT - ROT	LAW - RAW
FOAL - VOLE	ZOO - SUE
DIP - NIP	NEED - DEED
FENCE - PENCE	THAN - DAN
THAW - SAW	CHOP - COP
POOL - TOOL	FORE - THOR
YIELD - WIELD	FIT - HIT
LAP - RAP	LEST - REST

NAME _____ DATE _____

EXHIBIT 18: PHONETIC COMPOSITION OF DRT.

This is reproduced from Table 2 of Voiers (1967) (or Table 1, Voiers, 1971)
CONSONANT TAXONOMY USED IN THE CONSTRUCTION OF THE DRT (FORM III)

	/m/	/n/	/v/	/ð/	/z/	/ʒ/	/b/	/d/	/g/	/w/	/r/	/l/	/j/	/f/	/θ/	/s/	/ʃ/	/p/	/t/	/k/	/h/
Voicing	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	-	-	-	-	-	
Nasality	+	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Sustention	-	-	+	+	+	-	-	-	-	+	+	+	+	+	+	-	-	-	-	+	
Sibilation	-	-	-	+	+	-	-	-	-	-	-	-	-	-	+	+	-	-	-	-	
Graveness	+	-	+	-	-	o	o	+	-	o	o	+	-	-	o	o	+	-	o	o	
Compactness	-	-	-	-	+	+	-	-	+	-	o	+	-	-	+	+	-	-	+	o	
Vowel-like*	-	-	-	-	-	-	-	-	-	+	+	+	-	-	-	-	-	-	-	-	

* The DRT does not test for the apprehensibility of the opposition, vowel-like - nonvowel-like. However, test words are chosen so as not to confound this attribute with the six attributes for which discriminability is tested.

CONTEXT

The context within which the word is heard provides the greatest contribution to the word's intelligibility. There are many forms of context — grammatical, linguistic, situational, semantic, etc. An air controller has as much trouble understanding a tobacco auctioneer as either one would have in understanding a Japanese kabuki drama, yet each in turn can understand the gibberish that passes for language in his own work environment.

Sentence tests are often suggested as tests for evaluating communications equipments, or the hearing capabilities of the hard of hearing. Four general types of sentence tests have been developed: single-word answer tests ("What day comes after Tuesday?"), five-key-word sentences ("When the frost has come it is time for turkey"), colloquial speech, and synthetic sentences ("Down by the time is real enough").

Sample lists of sentences of the first two types, taken from Hudgins et al (1947), are shown in exhibits 19 and 20. Examples of colloquial speech, exhibit 21, were compiled by a CHABA working group chaired by Fairbanks and listed by Davis and Silverman (1970) in the appendix to the revised edition of Hearing and Deafness. Giolas (1966) has demonstrated a close relationship between the intelligibility of these colloquial sentences and that of samples of continuous discourse.

Speaks and Jerger (1965) and Jerger, Speaks, and Trammell (1968) developed sets of first-, second-, and third-order synthetic sentences to reduce the predictability of key words in regular English sentences while retaining many other good features of sentence testing. Their third-order sentences are shown in exhibit 22. Giolas, Cooker, and Duffy (1971) have shown that the synthetic sentences have indeed eliminated key word predictability as a factor in their sentence lists.

EXHIBIT 19: HUDGINS ET AL SENTENCES (SINGLE-WORD ANSWERS).

LIST 1

<u>Level</u>	<u>Answer</u>	<u>Question</u>
0 db	B	1. What letter comes between A and C?
	Yes	2. Do flies have wings?
	Monday	3. What day comes after Sunday?
-6 db	3 or 4	4. How many colors are there in the American Flag?
	11	5. What number comes after 10?
	Hammer	6. What tool do you drive nails with?
-12 db	7	7. What number comes between 6 and 8?
	Yes	8. Are moths dangerous to clothing?
	February	9. What month comes after January?
-18 db	5	10. How many pennies are there in a nickel?
	No	11. Is there a lot of water in the desert?
	Weak	12. What is the opposite of strong?
-24 db	9	13. What number comes before 10?
	Bullets	14. Does a gun shoot flowers or bullets?
	Old	15. What is the opposite of new?
-30 db	France	16. In what country is Paris?
	No	17. Do you climb mountains in a sailboat?
	X	18. What letter comes after W?
-36 db	Tuesday	19. What day comes after Monday?
	Light	20. What is the opposite of dark?
	12	21. What number comes after 11?

EXHIBIT 20: HUDGINS ET AL FIVE-KEY-WORD SENTENCES.

LIST 1

1. The birch canoe slid on the smooth planks.
2. Glue the sheet to the dark blue background.
3. It's easy to tell the depth of a well.
4. These days a chicken leg is a rare dish.
5. Rice is often served in round bowls.
6. John is just a dope of long standing.
7. The juice of lemons makes fine punch.
8. The chest was thrown beside the parked truck.
9. The hogs were fed chopped corn and garbage.
10. A cry in the night chills my marrow.
11. Blow high or low but follow the notes.
12. Four hours of steady work faced us.
13. A large size in stockings is hard to sell.
14. Many are taught to breathe through the nose.
15. Ten days leave is coming up.
16. The Frenchman was shot when the sun rose.
17. A rod is used to catch pink salmon.
18. He smoked a pipe until it burned his tongue.
19. The light flashed the message to the eyes of the watchers.
20. The source of the huge river is the clear spring.

EXHIBIT 21: EVERYDAY (CIVILIAN) SPEECH (50 OF 100 SENTENCES).

LIST A

1. Walking's my favorite exercise.
2. Here's a nice quiet place to rest.
3. Our janitor sweeps the floors every night.
4. It would be much easier if everyone would help.
5. Good morning.
6. Open your window before you go to bed!
7. Do you think that she should stay out so late?
8. How do you feel about changing the time when we begin work?
9. Here we go.
10. Move out of the way!

LIST B

1. The water's too cold for swimming.
2. Why should I get up so early in the morning?
3. Here are your shoes.
4. It's raining.
5. Where are you going?
6. Come here when I call you!
7. Don't try to get out of it this time!
8. Should we let little children go to the movies by themselves?
9. There isn't enough paint to finish the room.
10. Do you want an egg for breakfast?

LIST C

1. Everybody should brush his teeth after meals.
2. Everything's all right.
3. Don't use up all the paper when you write your letter.
4. That's right.
5. People ought to see a doctor once a year.
6. Those windows are so dirty I can't see anything outside.
7. Pass the bread and butter please!
8. Don't forget to pay your bill before the first of the month.
9. Don't let the dog out of the house!
10. There's a good ballgame this afternoon.

LIST D

1. It's time to go.
2. If you don't want these old magazines, throw them out.
3. Do you want to wash up?
4. It's a real dark night so watch your driving.
5. I'll carry the package for you.
6. Did you forget to shut off the water?
7. Fishing in a mountain stream is my idea of a good time.
8. Fathers spend more time with their children than they used to.
9. Be careful not to break your glasses!
10. I'm sorry.

EXHIBIT 21 (Continued).

LIST E

1. You can catch the bus across the street.
2. Call her on the phone and tell her the news.
3. I'll catch up with you later.
4. I'll think it over.
5. I don't want to go to the movies tonight.
6. If your tooth hurts that much you ought to see a dentist.
7. Put that cookie back in the box!
8. Stop fooling around!
9. Time's up.
10. How do you spell your name?

EXHIBIT 22: SPEAKS AND JERGER SYNTHETIC SENTENCES
(THIRD-ORDER APPROXIMATION TO ACTUAL ENGLISH).

Primary Subset

1. SMALL BOAT WITH A PICTURE HAS BECOME
2. BUILT THE GOVERNMENT WITH THE FORCE ALMOST
3. GO CHANGE YOUR CAR COLOR IS RED
4. FORWARD MARCH SAID THE BOY HAD A
5. MARCH AROUND WITHOUT A CARE IN YOUR
6. THAT NEIGHBOR WHO SAID BUSINESS IS BETTER
7. BATTLE CRY AND BE BETTER THAN EVER
8. DOWN BY THE TIME IS REAL ENOUGH
9. AGREE WITH HIM ONLY TO FIND OUT
10. WOMEN VIEW MEN WITH GREEN PAPER SHULD

Secondary Subset

11. OWN LOT IN YOUR AMERICAN FOOD HAS
12. IS MEETING IN THE COLLEGE OF THE
13. US WITHOUT FIRST THOUGHT WAS VERY NICE
14. AGREE WITH US IT ONLY SHALL COOK
15. WITH HUMAN NATURE CAN BE MET AT
16. IN OUR DIFFERENT NAME BECAUSE HE CAN'T
17. MARCH AROUND THE TIME WAS EVERYTHING THAT
18. MORE OF IT IS CERTAIN TO BE
19. WILL GO TO SCHOOL TODAY WAS THE
20. SO ALLOW US TO THE SOUND AND

VALIDITY FACTORS

To evaluate operational equipment, or the performance of operating personnel, the test language and talker/listener team should be related in some known way to the language and personnel actually employed on the system (equipment, component) under test.

The use and/or pronunciation of certain digits, words, and short phrases are specified in specific operational situations. For example, exhibit 23 lists (at the bottom) the International Civil Aeronautics Organization (ICAO) phonetic spelling words (see Moser and Dreher (1955)) and digit pronunciation, and (at the top) a selected list of Brevity Code words for naval aircraft operations. This listing has been compiled for special testing of naval aircraft radios.

Webster and Allen (1972) reported on the speech intelligibility of USN aircraft radios and in the process made some recordings of radio transmissions of a squadron of USN aircraft on a combat mission over the Republic of Vietnam. Some of these recordings are transcribed as exhibit 24.

Walker and Black (1950) prepared 20 flight phrases equated in intensity and duration for test purposes; see exhibit 25.

Major Donald Gasaway, of the USAF, has compiled a list of words extracted from many hours of in-flight recordings in USAF aircraft.* Gasaway's words are shown in exhibit 26, together with some statistics on how familiar the words are (frequency of usage per million words); whether they are represented in the standard word tests shown in exhibits 1, 7, 9, 12, and 17; and whether they are included among the Brevity Code words.

The U. S. Army Test and Evaluation Command (1971) has prepared the lists of tactical field messages shown in exhibit 27. The report specifies exactly how the testing is to be accomplished, to wit:

"The test project officer will designate the net stations to be used for transmitting and receiving initial messages and the type messages to be used. He will assure that stations are properly manned with qualified "talkers and listeners." After procedural messages have been exchanged, the designated "talker" will transmit the designated test message in a clear, strong voice, spacing the characters/words only to the extent that proper enunciation is effected. If messages selected from Exhibit 27 contain more than 10 words/characters, the "talker" must bear in mind that the messages are being transcribed by hand and pause after each 3 or 4 words. If practicable, tape record the test messages at the transmitting station for subsequent comparison with received messages in order to eliminate from evaluation errors made by the "talkers." "Listeners" at the receiving net stations will manually transcribe all test messages. Listeners should be required to add any appropriate comments relative to characters/words that may be missed or about which they are uncertain. Sufficient log entries will be

*Gasaway is now developing a test to evaluate the auditory performance of air crew members, in particular to test in situ experienced personnel who have lost some hearing acuity as determined by standard clinical tests on the ground. C. Williams and J. W. Greene are working on similar tests for naval air crewmen, see Greene (1970).

made at all stations to fully identify each test message. Selected transmissions will be recorded at the receiving station for comparison with recordings made at the transmitting station in order to evaluate the quality of the communications equipment being tested.

NOTE: For purposes of this test no repeats of test messages will be made.

"Transmitting and receiving responsibilities will be rotated among all or selected stations in the communication net in turn. "Talkers" and "listeners" will be rotated at each station for each test message to be transmitted. Sufficient test messages will be transmitted to give a high degree of confidence in the test results.

"Each manually transcribed test message will be checked against the transmitted messages to determine its accuracy.

"Individual letters and numerals will be pronounced using the phonetic alphabet."

Klumpp and Webster (1960) studied the language used on the flight deck of aircraft carriers as part of a study to evaluate man-worn radio equipment. One hundred and fifty flight deck phrases are listed in exhibit 28 and 100 words are extracted and listed in exhibit 29.

Webster and Henry in a report prepared for the SAMSF (Shipboard Aviation Maintenance Space and Support Facilities) Review Committee of NAVSHIPS, NAVAIR, and NAVSUP (see NAVSHIPS (1972)), have compiled the lists of aviation maintenance/supply support messages shown in exhibit 30. Note in this case the preponderance of alphanumeric symbols transmitted.

**EXHIBIT 23: BREVITY CODE WORDS FOR NAVAL AIRCRAFT OPERATIONS AND
INTERNATIONAL CIVIL AERONAUTICS ORGANIZATION
PHONETIC SPELLING WORDS.**

1. ABORT	49. CLARA	96. FLYING AT
2. ABORTING	50. CLEARED	97. FOX
3. AFFIRM	51. CLUTTER	98. FRAME
4. AFFIRMATIVE	52. COCKROACH	99. FREE LANCE
5. AIRBORNE	53. CODE	100. FRIENDLY
6. ALTITUDE	54. CONDITION	101. FUEL
7. ANCHORED	55. CONFUSED	
8. ANYCAP	56. CONTACT	102. GADGET
9. ANGELS	57. CONTINUE	103. GATE
10. ANGLE	58. COVER	104. GEIGER
11. ANY FACE	59. CREW	105. GERONIMO
12. APPROACH	60. CROSSING	106. GOBLIN
13. ARK		107. GOODYEAR
14. ASPRO	61. DADCAP	108. GRANDSLAM
15. ASSUME	62. DANGER	109. GRAPHIC
16. AUTOCAT	63. DAVEY JONES	110. GUESSER
17. AWAY	64. DAYRECCO	111. GUNS FREE
	65. DEAF	112. GUNS TIGHT
18. BABS	66. DECIMAL	113. GYRO
19. BARCAP	67. DECK CLEAR	
20. BASE	68. DECK FOUL	114. HARD
21. BATTERY	69. DECOY	115. HAWK
22. BAY RUM	70. DELTA	116. HEADING
23. BELLHO?	71. DETACH	117. HEADS UP
24. BENCH MARK	72. DITCH	118. HECKLERS
25. BENT	73. DITCHING	119. HELOT
26. BINGO	74. DIVERT	120. HELP
27. BINGO FIELD	75. DOLLY	121. HIGH
28. BINGO STATE	76. DRONE	122. HOLD
29. BIRD	77. DUCKBUTT	123. HOLDING
30. BLIND	78. DUD	124. HOMER
31. BOGEY	79. DUMBO	125. HOTEL FIRE
32. BOWWAVE		126. HOSTILE
33. BREAK	80. EASE TURN	127. HUGO
34. BROWNIE	81. ELEVATOR	128. HUNTSMEN
35. BULLMOOSF	82. EMERGENCY	129. HUSH
36. BUSTER	83. EMERGENCY SPACE	
	84. ENGAGE	130. IDENT
37. CAP	85. ESTIMATE	131. IDENTIFY
38. CAPREP	86. EVERGREEN	132. I GO
39. CAUTION		133. INTERFERENCE
40. CAVU	87. FADED	134. IN THE DARK
41. CEASE REPORTING	88. FAMISHED	135. INTRUDERS
42. CHARLIE	89. FEAR	136. I STAY
43. CHASE	90. FEET DRY	137. JUDY
44. CHECK	91. FEET WET	
45 CHERUBS	92. FERRET	138. KEEPER
46 CHICKS	93. FEW	
47. CHOPPER	94. FINAL	139. LAMPS
48. CIGAR	95. FLY AT	

EXHIBIT 23 (Continued).

140. LAND	186. PARTNER	234. SKUNK
141. LAUNCH	187. PEDRO	235. SKYROCKET
142. LAZY	188. PIGEONS	236. SLINGSHOT
143. LEFT	189. PLAYBOY	237. SMOKER
144. LEVEL	190. PLUS	238. SNOOPER
145. LIFEGUARD	191. PLUTO	239. SOUR
146. LIGHTS	192. POGO	240. SPLASHED
147. LINER	193. POINT	241. SPLITTING
148. LINK	194. POPEYE	242. SPOTTER
149. LOCAP	195. PORT	243. SPOOFER
150. LOST	196. POSITION	244. SQUAWK
151. LOW	197. POUNCE	245. SQUAWKING
152. MACK NO	198. PREP CHARLIE	246. STARBOARD
153. MACK YES	199. PRONTO	247. STATE CHICKEN
154. MAKER	200. PUNCH	248. STATE LAMB
155. MANY	201. PURPLE	249. STATE TIGER
156. MAPPO	202. RAID	250. STATE WEAPONS
157. MAYDAY	203. RAMROD	251. STEADY
158. MEDIUM	204. RANGE	252. STEER
159. MERGED	205. RAPCAP	253. STOP
160. MIDDLEMAN	206. READY	254. STRANGER
161. MIDNIGHT	207. RECCO	255. STRANGLE
162. MINUS	208. RECKON	256. STRIKE
163. MIXUP	209. RELIABLE	257. SUBCAP
164. MUSHROOM	210. REPORT	258. SWEEP
	211. RESCUECAP	259. SWEET
165. NANCY	212. RIALTO	260. TALLY-HO
166. NEGATIVE	213. RIGHT	261. TARCAP
167. NIGHTCAP	214. ROUTE	262. TARGET
168. NIGHTRECCO		263. TASP
169. NOCOP	215. SAINT BERNARD	264. TIED ON
170. NODUF	216. SALVOS	265. TIPS
171. NO JOY	217. SAPPHIRE	266. TOOL
172. NORMAL	218. SAUNTER	267. TOUCH
173. NOT	219. SAY	268. TRACK
	220. SCAN	269. TRACTORS
174. O'CLOCK	221. SCENE COMMANDER	270. TRADE
175. OCTOPUS	222. SECTOR	271. TRAILOR
176. OKAY	223. SCRAMBLE	272. TRANSPOUNDER
177. ON STATION	224. SCRUB	273. TRIDENT
178. ON TARGET	225. SECURITE	274. TROT
179. ON THE CLOCK	226. SEE YOU	
180. ORANGES	227. SHADS	275. UNABLE
181. ORBIT	228. SHECAT	276. UNKNOWN
182. ORBITING	229. SICK	
	230. SINGLE	277. VECTOR
183. PAN	231. SITREP	278. VERY
184. PANCAKE	232. SHIP	279. VISIBILITY
185. PARROT	233. SKIP IT	

EXHIBIT 23 (Continued).

280. WARNING RED	285. WEAPONS FREE	290. WHAT STATE
281. WARNING WHITE	286. WEAPONS TIGHT	291. WHICH TRANS-
282. WARNING YELLOW	287. WEATHER	PONDER
283. WATCH	288. WELL	
284. WAVE OFF	289. WHAT LUCK	292. YELLOW JACKET
		293. YELP

PHONETIC ALPHABET AND NUMERALS

1. ALFA	13. MIKE	24. X-RAY
2. BRAVO	14. NOVEMBER	25. YANKEE
3. CHARLIE	15. OSCAR	26. ZULU
4. DELTA	16. PAPA	27. WUN
5. ECHO	17. QUEBEC (pronounced Kay-beck)	28. TWO
6. FOXTROT	18. ROMEO	29. THU-REE
7. GOLF	19. SIERRA	30. FO-WER
8. HOTEL	20. TANGO	31. FI-YIV
9. INDIA	21. UNIFORM	32. SIX
10. JULIETT	22. VICTOR	33. SEVEN
11. KILO	23. WHISKEY	34. EIGHT
12. LIMA		35. NI-NER
		36. ZERO

EXHIBIT 24: TRANSCRIPTION OF NAVAL AIRCRAFT RADIO AND ICS
TRANSMISSIONS.

... zero, over.

Pine 1, Big Tiger 102,* how do you hear?

Roger 012, read you loud and clear ana Pin. Bark 110 and Pine Bark 105 will be Pine 1 & 2 up for your control.

Roger, and 110 will be Pine 1?

110, affirmative.

Roger, 1 & 2, vector 140 for station.

And Pine Bark station will be on the 135, about twenty-five miles from South Gate. How's the weather look out there?

Oh, the overcast _____.

Roger - when through, level at angels twenty-two point five, and it's pretty clear above.

Roger.

Pine 1, this is Big Tiger _____ request you strangle your parrot. Pine 2, squawk normal.

Pine 2, parrot sweet - 1, go back to normal, please.

And Pine 1, verify heading 140.

Roger, passing 170 for 140.

Pine say your state now, please.

Did not copy it, Pine 2 what's yours, and will you pass Pine 1's?

Pine 1, Big Tiger.

*102 spoken as one zero two

EXHIBIT 24 (Continued).

Pine 1, Go ahead.

Roger, say your state, please.

 5 plus.

Roger. Pine 2 what's your state?

Above that.

Roger.

This is Big Tiger, we're a little far from you. We're moving up there.
You're very broken. How do you hear me?

Roger, Pine 1 vector 090 for separation -- Pine 2 starboard 180 for separation

Pine 1 090

Pine 2 180

Pine 1 & 2 in the event of no communications for any 1 minute period, attempt
contact Big Tiger Button 8. If no joy, attempt contact South Gate, proceed
overhead South Gate, over

Pine 1 copy.

Pine 2, you copy lost comm?

That's affirmative.

Pine 1, you want to be the first shoot?

Roger.

Pine 1, Big Tiger, I'll make the short one, uh, the first one at about twenty
miles separation to get started. Then we'll make it a little more after that.

Roger

Pine 2, port 050 as the bogey, over.

 050 -.

Pine 1, starboard 230 for a bogey, over.

EXHIBIT 24 (Continued).

Pine 1, 230

Pine 2, your bogey 224 at seven-teen (should have said Pine 1)
1, roger

1, your bogey 230 at eighteen

1, your bogey, single, altitude medium

Roger

1, when steady (on heading 230) your bogey's at 050, indicating point 6
(speed mach 0.6), out

1, speed and angles as desired, check your switches safe.

1, switch-e-s safe.

1, your bogey 226 at nineteen

1, your bogey 225, seventeen

1, your bogey 224, eleven, Break, port 220

Steady 220

Roger, your bogey 223 at ten

Bogey now 225 at 8. 1, Starboard 230

1, 230

1, your bogey now 230 at 5

Tally:

Roger tallyho, your bogey now 230 at 2

Bogey now coming 230 about 1

1, your bogey should be passing your left wing. Break away 250

1, you were very broken.

Skip it.

Roger, skip it. Continue 230. 2, continue 250.

Roger, your break away pigeons were 318 at thirty-six.

1, what state?

EXHIBIT 24 (Continued).

Pine 1, Big Tiger bears 257, twenty four miles from you. Big Tiger's level at twenty-two point five.

Roger

2, what state?

Thirteen point four, approximately.

Roger, and 1, your state?

1, affirmative.

2, starboard 240 as the bogey, over

2, starboard 240.

1, port 060 for the bogey, over

060

1, your bogey 057, twenty-five, out

1, same bogey information as before, or do you wish any repeated?

Roger, check Switches safe.

1, your bogey now 058, thirty-one

1, is your dolly up?

1, you were broken - understand your dolly is up?

1, affirm.

Roger, request you say your dolly information.

1, show bogey 062, thirty

EXHIBIT 24 (Continued).

Roger 060, and say command head

This is 012, understand no command head

Roger, bogey 066, twenty-five. Are you receiving an RM-1 indication?
("Arm Warning"?)

Roger

1, your bogey 066, nineteen, command heading should be 060. Do you concur?

_____ at fifteen miles.

_____ your heading 240

Roger Judy

_____ # _____

Roger, your brea-k away 060

Breakaway pigeons 316 at thirty-seven

2, continue 240

2, is your dolly working?

Affirmative

Roger, we'll try to hook you up on this run

1, what state?

Twelve point three

Roger, - 2?

Twelve point three

1, come port 230 as the bogey, over
230

2, starboard 050 for bogey, over

.Starboard 050

2, your bogey 247, twenty-three

2, your bogey single, altitude medium, out

2, when steady your bogey heads 230, indicating point 7, out

2, speed and angels as desired, check your switches safe, over

Switches safe

2, your bogey 050, twenty-eight

2, your bogey 053, at thirty

2, this is Big Tiger, do you have any dolly information, over?

2 has no dolly information

Roger 2, if you get any dolly information, would you please pass it?

2, your bogey is 050 at twenty-four
("Arm Warn"?)

2, I have an RM-1 now

Roger, do you have a command head or a range and bearing?

Standby one

Your bogey's now 049, sixteen

2, your bogey 048, fourteen

Roger 2, I have a Judy

EXHIBIT 24 (Continued).

Roger Judy
And command heading of 047
This is 012, concur

Understand simulated _____?

Roger, skip it, break away will be 060
Roger, coming to 060
Break away pigeons 349, thirty-four
1, what state?
Eleven point five
Roger, 2?
2 is Twelve point two
Roger two, we'd like to try a machine drive arm 2 this time if you could.
Roger,
We'll get you a way point
1, Big Tiger, do you have Big Tiger on your 300, seventeen miles, southbound?

2, do you hold your way point on your 060 at thirty?

2, affirmative

Roger

Roger, now 068?

Affirmative

Pine 2, this is Big Tiger, port 030 as the bogey, over
Pine 2, coming port to 030. And Pine 2 is the target?

Disregard, Pine 1, come port 030

Pine 1 to 030

And Pine 2, starboard 210 for a bogey, over

Pine 2, roger.

Pine 2, your bogey 215, twenty-five

Pine 2 has another target

That's affirm; we're taking you from way point to your assignment

Pine 2, your bogey now 1....your bogey now 0224, thirty-two and you should
have an orbit light just going out.

This is Pine 2, arm 1

Roger

And a command heading of 090, thirty-two

This is 012, concur. _____ arm 2.

And it's still on normal.

This is 012, roger. It should take it a second to catch

Judy, 220 at twenty

EXHIBIT 24 (Continued).

Roger

2, radio check
Loud and clear

And a simulated Fox (Fire ?) 1, and let's take a breakaway and get situated
as a bogey

Roger, breakaway for 2 will be 150

Roger, 2's coming to 150

And 1 breakaway 030

1 is steady

Roger, your breakaway pigeons are 356, twenty-nine

This is 012, concur

And 1, Big Tiger are you copying your way point

1, standby

1, negative; we do have _____ and a command heading and airspeed. 030

Roger it should be 030 for a command heading. Should have just changed to 020

2, port 020 as the bogey, over

2, coming port 020 as the bogey

1, starboard 160 for bogey, over

1, your bogey 178, twenty-four

1, your bogey 177, twenty-seven

1, your bogey 174, twenty-eight

1, your bogey 175, twenty-seven

Bogey now 176, twenty-five

Bogey now 179, twenty

Bogey now 180, eighteen Break, hard starboard 190

1, has contact, appears to be about fifteen miles

Roger that's your bogey

Judy

Roger Judy

1, understand Fox 2, your breakaway 190

2, your breakaway 350, and 1 or 2, did you copy?

Pine 1, Big Tiger

Go ahead

Roger, your breakaway 190, did you copy?

1, your breakaway pigeons were 314 at twenty-seven

2, port 210 as the bogey, over

Roger

1, starboard 030 for a bogey, over

1, starboard 030

2, did you copy port 210?

Affirmative, coming to 210

EXHIBIT 24 (Continued).

Roger. 1, your bogey 025 at twenty-8
1, roger, and be advised you're breaking up again
Roger, we're coming back to you now
1, your bogey 014, thirty-1
1, steady 360 ("Stop your turn and steady up on heading 360)
Roger
1, your bogey 012, thirty-1
1, steady
Roger steady, your bogey 012, twenty-8
1, your bogey 010, twenty-u, just completing a port turn
1, your bogey 009, twenty-6
1, your bogey 009, twenty-4
1, your bogey 009, twenty-2
1, your bogey 009, nineteen
1 has contact at fifteen miles
Roger, that's your bogey, heading 210

This is 012, your bogey now 003, fourteen
Have a Judy
Roger Judy
1, steady up. _____ ten miles.

Lost contact
Roger, your bogey 335, 7
Bogey now 324, 7, Break, come port 270
Bogey now 307, 6. Come hard port 210
Bogey now 286 at 7, moving away
Bogey now 272 at 8
Bogey now 257 at 8
Judy
Roger Judy
1, skip it.
Roger skip it, your breakaway 030
1, roger, 030
1, your breakaway pigeons are 323 at twenty-2 miles
1, what state?
1, state ten point four
2, what state?
2, state ten point 1
Roger
Understand 2 is the target this time
Roger, 2 will be the target this time
_____ we have no TACAN.

Roger, understand negative TACAN. And who's that - 1 or 2?

EXHIBIT 24 (Continued).

That's for Pine Bark 1

Roger 1

And _____

That's affirmative

O.K. I'll try to check you out when we _____.

About forty degrees

OK, I didn't really know, but I think my _____ are in Stabilization.
2, Big Tiger, you receiving the way point excitement?

2, that's affirmative. 192 at twenty-1

012, concur

And 1 is steady 020

Roger steady

1 is now level at eighteen point five and completely VFR down here.

Roger; 2 say angels

Angels nineteen point five

Roger, did you copy 1?

2 is going lower

1, Big Tiger, starboard 180 as the bogey, over

1, starboard 180

2, port 060 for the bogey, over

2, port 060 to complete intercept

2, your bogey 026 at thirty-2

And 2, Big Tiger, could I track cat's eye this time?

See you

2, Big Tiger, could I track cat's eye this time?

Say again?

Roger, could I track cat's eye this time?

Certainly

Roger, your bogey now 026, thirty-6

Roger

Pine 2, steady 060

Roger

Pine 1, steady 180

Pine 2, your bogey 028, thirty-2

2, your bogey 029, twenty-9

2, continue 060

2, your bogey 028, twenty-8

2, your bogey 027, twenty-5

Roger! Contact! Two Five at twenty-2

2, that's your bogey, heading 180

Roger

2, port, 0°0

Port, 040

2, your bogey 027, twenty

EXHIBIT 24 (Continued).

Roger steady, your bogey now 028, at seventeen
Show him 020 at _____
Roger come hard port 340
340?
Roger
Wilco!
Your bogey now 018, sixteen
Your bogey now 018, thirteen
Your bogey 026, ten
Your bogey 030, seven
Bogey 050, 5, mark starboard 180, bogey head
Bogey 061, 3
Bogey 071, 2
Bogey 148, 1
Bogey 150, 1
Bogey 165, 1
And that ought to be about the finish
Roger, call final position, please
Roger, we were about a mile, six o'clock
Roger, your breakaway 360
Roger 360. That was a pretty good run
Thank you. Your breakaway pigeons 336 at thirty-6 and say state
State about nine point 7
Roger
And 2, Big Tiger, how's the weather out there where you are?

Roger.
1, your pigeons are now 339 at forty-5
South Gate, Over.
This is 012, Roger - he still
I. AND JIM, STAGE WANTS US TO COME UP TACTICAL SECURE -- I DON'T KNOW WHAT FOR.
Affirmative
And Stage Coach, 012.
I. AND I'VE CHECKED IN ON PIRAZ.
012, South Gate
I. OK, _____, CAN WE HEAD 180?
I. OK
And
xxx Pine 2, Big Tiger understand you are receiving _____ this time?
(buzz buzz buzz)
Pine 1, Big Tiger, I am unable to read Pine 2 - can you pass?
This is Pine 2 (broken) how do you read me now?
Big Tiger, do you have _____ any bogey dope for us?
Uh, Roger Pine 2, come starboard a long ways, 340.
Coming starboard 340
And 2's level eighteen 5 (18,500 feet) (Angels eighteen point five")
Roger 2 and starboard 340. 1, port 160.
1, port to 160

EXHIBIT 24 (Continued).

1, your bogey 168, twenty-five.
1, roger.
1, check your switches safe.
1, switches safe, (state) twenty-three ninety-seven
1, your bogey 171, twenty-six.
1, your bogey 175, twenty-five
1, your bogey 175, twenty-three
And 2's steady 340
Roger steady
1, your bogey 173, twenty-two
1, is steady 160
Roger steady, starboard 190
1, roger
1, your bogey 172, twenty-one
1, hard port 150
1, roger
1, your bogey 173, fifteen
1, your bogey 172, thirteen
1, your bogey 170, eleven/ cause you have the 180.*
1 has the duty/coming that direction as far (high?) as I can*
OK/Let's not make this a ____.*
Roger continue to 150/I'm not sure I can hold it though if the weather../Going
to 150/OK*
They're about.. uh/1, your bogey 180/fifteen miles out on your port wing/
correction, 180, five.*
1, your bogey 200, five
1, hard starboard 340, bogey heading
I got him
1, your bogey 211, six
1, your bogey 230, five
1, your bogey 270, three
1, your bogey 290, two
1, your bogey 320, two
1, your bogey 333, two and a half
1, show your bogey on the nose, two miles
1, your bogey 340, two
1, Roger, you want to break away and set up a new one?
Roger, break away. Be advised Big Tiger is on your 272, eleven miles. Your
break away 160.
1, roger your ranges were a little long this time.
This is 012, roger, could you say final position, please?
Roger, we were six o'clock at about four miles and your contacts originally
were about four miles difference in distance I was indicating on the (UCR?2)
012, Roger
This is Pine 2, I had the ranges right on
Did you?
And Big Tiger, shifting my weapons.
Roger/About a mile behind

*----/----

Transmissions from 2 groups overriding
each other on the same frequency

EXHIBIT 24 (Continued).

2, what state?

Pine 2, Big Tiger, say state?

Pine 2, state 8 point oh.

Roger, Pine 17

Pine 1, 8 point 6

Roger

1 from 2

go ahead

I. WHEN'S OUR E-A, OUR NEW E-A-C OF TWENTY THIRTY-SEVEN.....RECOVERY
OF TWENTY FORTY-FIVE.

Pine 1, Big Tiger, port to 360 has the bogey

1, port to 360

Pine 2, Big Tiger, Starboard 160 for a bogey

2, coming starboard to 160

2, your bogey 169, twenty-eight

Say Pine 1 heading again

Roger Pine 2, 3 - correction, Pine 1 is 360

Pine 1, Roger

And Pine 2 is 160.

I. COMPARE WITH YOUR TIME IF THE LAUNCH GOES AT TWENTY FORTY-FIVE?

I. I'M CHECKING THE POSITION, OVER.

Pine Bark, this is Big Tiger, we're getting your Charlie time right now

1, roger.

2, your bogey 175, thirty-eight.

I. DID YOU CALL MARSHAL, .. CANCEL ...?

I. I'LL CALL.

I. DO YOU WANT US TO CALL MARSHAL TO GET THE MARSHAL INFO FOR YOUR PINES?

I. YEAH, CAN YOU?

I. OK. THAT'S 110 AND 105, RIGHT?

I. RIGHT.

... 179, twenty-nine/OK

2 is steady 160

Roger, you bogey is 182, twenty-seven, starboard 180

180, roger

2, your bogey 180, twenty-three

2, your bogey 180, nineteen, port 150

And 2 has a contact, 185 at eighteen

That's your bogey, heading 360

Roger, got him

Roger, goody

Very garbled, say again

Pine 1, radio check

1, read you loud and clear

EXHIBIT 24 (Continued).

'This is Big Tiger, Pine 1, read you loud and clear.

Roger Dog 1, you ready to break away?

That's affirm, Big Tiger, did you come up with that approach time for us?
We're still working on getting it.

Say pigeons. 2, I'm starting a port turn -- join. ("Join up with me")
Roger

Roger, your pigeons are 318 at twenty-four.
And 110, your time is 50, over.

Roger, copied.

EXHIBIT 25: WALKER AND BLACK FLIGHT PHRASES.

- 1) The 20 five-syllable flight phrases were taken from:
Walker, Crayton; Black, John W., The Intrinsic Intensity of Oral Phrases (The Ohio State University Research Foundation, Columbus, Ohio, and the U. S. Naval School of Aviation Medicine, 1950), p. 9-14.
 - 2) These phrases are equated for mean intensity and duration.
 - 3) Each order is a different randomization of the same 20 five-syllable phrases.
 - 4) There is a total of six orders.
- | | |
|------------------------------|------------------------------|
| 1. Speed is kept constant | 1. Rough terrain below |
| 2. You have no power | 2. You press right rudder |
| 3. Rough terrain below | 3. The glide is broken |
| 4. Slip close to the ground | 4. Slip close to the ground |
| 5. The glide is broken | 5. The brakes can be used |
| 6. Head into the course | 6. Always keep flying |
| 7. Release the pressure | 7. Practice these landings |
| 8. Practice these landings | 8. Drop off to one side |
| 9. Dive down to a field | 9. Unlock the tail wheel |
| 10. Turn into the wind | 10. Pull the stick back more |
| 11. Try some circle shots | 11. Reset the throttle |
| 12. Drop off to one side | 12. Try some circle shots |
| 13. Unlock the tail wheel | 13. The plane is climbing |
| 14. The brakes can be used | 14. Vary your pattern |
| 15. Pull the stick back more | 15. Speed is kept constant |
| 16. Reset the throttle | 16. You have no power |
| 17. Always keep flying | 17. Head into the course |
| 18. The plane is climbing | 18. Turn into the wind |
| 19. Vary your pattern | 19. Dive down to a field |
| 20. You press right rudder | 20. Release the pressure |

EXPLANATION OF CODING IN EXHIBIT 26:

Symbols appearing in columns 2, 4 and 6 denote word-frequency counts (occurrences per million words), from Thorndike, E. L. and Lorge, I. (1952) and inclusion in one or more of the five word tests used in the study, as follows.

First symbol (occurrences per million words):

AA = at least 100 occurrences/million words

A = between 50 and 100 occurrences

Numerals 1 through 49: designated number of occurrences under 50

- = not counted.

The second through the sixth symbols in these columns indicate that the word is included in one or more of the following word lists:

Letter = Word List

P = Egan's Phonetically Balanced Words

F = Fairbanks Rhyme Test

M = Modified Rhyme Test of House et al. as modified by Kreul et al.

V = Clarke's Vowel Test

D = Voiers's Diagnostic Rhyme Test

Thus the word "bit" as it appears on the list may be identified as follows:

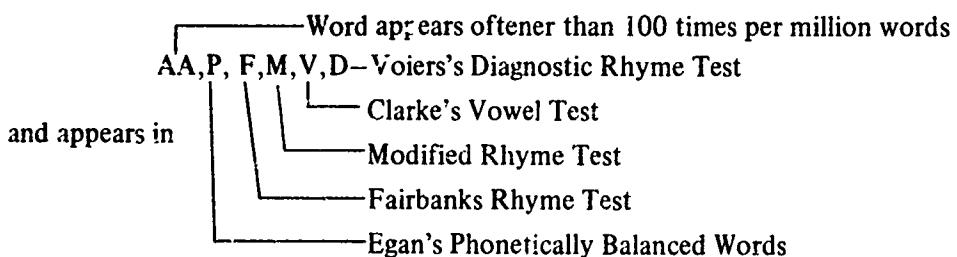


EXHIBIT 26: AIRCRAFT COMMUNICATION WORD LIST.

A. SINGLE WORDS

a	AA	bank(ed)	AA	boot	37
ABORT(ING)	-	bar	A,P	bore	A,F
add	AA,Y	BARCAP	-	bern	AA,F
AFFIRM	10	bare	A	botch(ed)	-
AFFIRMATIVE	3	barge	12,P	both	AA
aft	4	barn	45,P	bounce(d)	10,P
aid(s)	A,P	base(d)	AA,P	bound	A,V
aim(ed)	A,P	bat	19,P,M,D	BOWWAVE	-
air	AA,P	BATTERY	19	brace	17,P
AIRBORNE	-	batch	3	brakes	23
aisle	12	bay	AA,P	branch	AA
ALFA	-	be	AA	BRAVO	1
all	AA,P	beach(ed)	A,M	break	AA
alley	13	beam	42,P,M	bridge	AA
alp	-	beat(s)	AA,F,M,D	brief	A
ALTITUDE	14	been	AA	bright	A'
am	AA,P	BELLHOP	-	brim	13
an	AA	bend(-t)	48,F,M,V,D	bring	A'
ANCHORED	26	best	AA,P,F,M	brink	8
ANYCAP	-	bet	23,P,V	brisk	9
and	AA,P	big	AA,P,F,M	broad	A,V
ANGELS	47	bind	39,P,V	broiled	9
ANGLE	30	bit	AA,P,F,M,V,D	broke	A
any	AA	black	AA,P	brown	AA
APPRCACH	A	blade(s)	32	BROWNIE	6
apt	AA,P	blare	2	budge(d)	4,P
arc()	9,P	blast	31	build	AA
arch(ed)	34,P	blaze	42	bulge	5
are(n't)	AA,P	bleak	9	BULLMOOSE	-
arid	AA	bleed	16	bum	6
ARK	7	blind	A,P	bury	-
arm(ed)(s)	AA,P	blow	AA	burn(ed)(t)	AA
as	AA,P	blob	-	burst(s)	A
ask(ed)(s)	AA,P	block	A	bus	9,P,M
ASPRO	-	blow(n)	AA	bust	13,P,F,M
ASSUME	A	blue	AA	BUSTER	-
at	AA,P,V	bluff	12,P	but	AA,P,M
AUTOCAT	-	blur(red)	8	buzz(ed)	16,P
AWAY	AA	board(s)	AA	by	AA,P
aye	16	boat(s)	AA,V	bye	1
BABS	-	bog(ged)(gy)	9,P	cab	15,P
back	AA,P,F,M	BOGEY	-	cage	30,P,F
bal	AA,P,M,V,D	bolts	27,P	call(ed)	AA,V
bag(ed)	AA	bomb(s)	13,D	calm(ed)	A
ball	AA,P,V	book	AA,P,F,M	came	AA,F,M
ban	2,M	boom	19	camp	AA,P
band	A,V	boost	2,P	car('t)	A
bang	14,F,M			cap	

EXHIBIT 26 (Continued).

cape	34, P, M	clank	2	COVER	AA
CAPREP	-	clap	22	cowl	5, V
car(s)	AA, P	CLARA	12	crack(ed)	48, P
card	A	clash	12, P	craft	21
care	AA, D	clasp	27	cram	6
carve	26, P	class	AA, P	cramp(t)	8
cat	A, P	clean(ed)	AA	crane	9
catch	AA, P	clear(ed)	AA	crank	8
cause(d)	AA	clew	2, P	crash(ed)	34, P
CAUTION	15	click	10, P	crate	7, P
CAYU	-	cliff(s)	38, P	crawl	31
cease	A	climb	A, P	creak	9
cell(s)	A	clinch	3	creep	36
chaff	7, P	cling	24, P	crest(s)	18
chain	A, P	clip	16, P	crew(s)	46, P
chance	AA, P	cloak	28, P	crisp	15
change(d)	AA, P	clock(ed)	A	crook	10
chap	14, P	clog(ged)	4, P	cross(ed)	AA
charge(d)	AA, P	close(d)	AA, P	(ing)	
CHARLIE	42	cloud(s)	AA, P	crow	37
chart(s)	15, P	clue(s)	4, P	crowd	AA, P
chase(d)	48	clump(ed)	9	crown	A
chat	12, P	clung	18	crude	17, P
CHERUBS	-	clutch	21, P	cruise	10
check(ed)	AA, P	CLUTTER	2	cub	11, P, M
chew	14, P, D	coach	42	cube	9
chick(s)	15	coarse	28	cue(d)	3, P
chief	AA	coast	A, P	curb	14, P
chill(ed)	43, P	coax(ed)	10, P	curl	45
chin	27	COCKROACH	1	curve(s)	36, P
chip	17, P	code	21, P		
chirp	8	coil	13, F, M, V		
chock(s)	3, D	cold	AA, F, M		
choice	A	colt	21		
choke(d)	27	cone(s)	AA, P		
choose	A, P, D	CONDITION	AA		
chop(per)	29, P, D	cone	7		
chose	A, P	CONFUSED	25		
chuck	9	CONTACT	31		
chuys	1	CONTINUE	AA		
chum	4	cope	10		
chunk	3, P	core	7		
churn(ed)	4	cork	11, P		
chute(s)	2	cost	AA, P		
CIGAR	16	cough(ed)	18		
cinch	1	could	AA		
cite	1	count	AA		
clamp(ed)	10	course	AA, P		
clancy	-	cove	5		

EXHIBIT 26 (Continued).

<u>cut(s)</u>	AA, P	<u>down</u>	AA, V	<u>end</u>	AA, P
<u>cycle(d)</u>	8	<u>dreg(ged)</u>	A	<u>ENGAGE</u>	A
DADCAP	-	<u>draw(n)</u>	AA	<u>enter</u>	AA
<u>damp</u>	27	<u>dread</u>	45	<u>entry</u>	17
DANGER	AA	<u>drench(ed)</u>	7	<u>equal</u>	A
dark	AA, F, M	<u>dried-(s)</u>	26	<u>error</u>	36
darn	12, P	<u>drifts(s)</u>	36	<u>ESTIMATE</u>	40
dart	33, P	<u>drink(s)</u>	AA	<u>even</u>	AA
dash	A, P	<u>drive</u>	AA	<u>ever</u>	AA
<u>date(s)</u>	AA, F	<u>drizzle</u>	1	<u>EVERGREEN</u>	9
<u>dawn(ed)</u>	A, V	<u>drone</u>	7	<u>eye</u>	AA, P
<u>day</u>	AA, P, F, M	<u>drop(ped)(s)</u>	AA, P		
DAYRECCO	-	<u>drove</u>	A	<u>face</u>	AA
<u>dead</u>	AA, P	<u>drug</u>	24, P	<u>fact(s)</u>	AA, P
<u>deaf</u>	19, P	<u>drum</u>	40	<u>fade(s)(d)</u>	41, P
<u>deal</u>	AA, F	<u>dry</u>	AA	<u>fag(ged)</u>	3
DECIMAL	1	<u>dual</u>	2	<u>fail(s)</u>	AA, F, V
deck	A, P, D	<u>duck(ed)</u>	49, F, M	<u>faint</u>	A
DECOY	3	<u>duct</u>	1	<u>fair</u>	AA, V
deep	AA, P	DUCKBUTT	-	<u>fall</u>	AA, P
DELTA	8	<u>dud(s)</u>	M	<u>false</u>	A
dense	19, D	<u>due</u>	AA	<u>FAMISHED</u>	4
DETACH	8	<u>dug</u>	26, M	<u>fan</u>	38, P, D
dew	30	<u>dull(ed)</u>	48, P, M, V	<u>far</u>	AA, P, V
<u>dial(s)</u>	8	<u>dumb</u>	34, P, V	<u>fast</u>	AA, P, F, D
<u>did(n't)</u>	AA, P, F, M, D	DUMBO	-	<u>fault</u>	A, D
<u>die</u>	AA	<u>dump(ed)</u>	10, F	<u>FEAR</u>	AA, V
<u>differ</u>	30	<u>during</u>	AA	<u>feat</u>	13, M
<u>digit</u>	-	<u>dusk</u>	14, F, M	<u>fed</u>	41, P, F, M
<u>dim(ed)</u>	37, M	<u>dust</u>	A	<u>feel(s)</u>	AA, P, F, M, D
dime	11, P, V	<u>duty</u>	AA	<u>feet</u>	AA, P
<u>dip(s)</u>	34, P, F, M, D	<u>dwell(ed)(s)</u>	44	<u>fell</u>	AA, P, F, V
<u>disk</u>	8	<u>dye</u>	23	<u>felt</u>	AA
<u>ditch(ed)</u>	28, P			<u>fence</u>	A, D
<u>ditching</u>	28, P	<u>each</u>	AA, P	<u>FERRET</u>	2
<u>dive</u>	21, P	<u>eager</u>	39	<u>few</u>	AA, P
DIVERT	11	<u>eagle</u>	38	<u>field(s)</u>	AA
<u>do</u>	AA	<u>early</u>	AA	<u>fifth</u>	A, P
<u>dodge(d)</u>	16, P	<u>earth</u>	AA, P	<u>fifty</u>	AA
<u>does(n't)</u>	AA	<u>ease(d)</u>	A, P	<u>fight</u>	AA, F, V
<u>dog</u>	AA, P	<u>east</u>	AA	<u>file</u>	43, F, V
DOLLY	8	<u>easy</u>	AA	<u>fill(ed)</u>	AA, P, F, M, V
<u>dome</u>	15, V	<u>eat</u>	AA, P, V	<u>film</u>	31
<u>done</u>	AA, P	<u>echo</u>	42	<u>fin</u>	6, P, M, D
<u>don't</u>	AA	<u>edge</u>	AA, P	<u>FINAL</u>	A
<u>door(s)</u>	AA	<u>eight</u>	AA	<u>find</u>	AA, P
<u>dot(s)</u>	38, P, D	ELEVATOR	15	<u>fine</u>	AA, P, F
<u>doubt</u>	AA, P	<u>else</u>	AA, P	<u>fire</u>	AA, F
<u>dove</u>	19, P	<u>EMERGENCY</u>	19	<u>firm</u>	A

EXHIBIT 26 (Continued).

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first	AA	frame	A	good	AA, P
fit	AA, P, F, M, V, D	free(d)	AA	GOODYEAR	1
five	AA, P	freeze	32, P	goof(ed)	-
fix	A	friend(s)	AA	goose	45, P, D
FI-YIV	-	FRIENDLY	A	got	AA, P, F, M, V, D
flag	A, P	fringe	17	grab(s)	18, P
flair	I	from	AA	grade	44, P
flame	A, P	front	AA, P	grand	A
flank(ed)	15, P	frost	41	GRANDSLAM	-
flap	16, P	froze(n)	5	grant	AA
flare	10, P	fuel(ed)	21	GRAPHIC	3
flash(ed)	A, P	full	AA	grasp(ed)	36
flat	A	fume(s)	8, P	grass	AA
flaw	6	funny	A	gray	AA, P
fled	35	fuse	7, P	graze(d)	16
fleet	A, P	gab	P, D	grease	16
flew	A	GADGET	2	great	AA
flick	4, P	gage	2, P	green	AA
fling	15, P	gain	AA, F	greet	A, P
flip(ed)	3, P	gale(s)	15, M	grew	AA, P
float	A, P	game(s)	AA, F, M	grey	19
flock	44	gang	25, P, F, M	grid	-
flood	A, P	gap(s)	17, P	grim	22
floor	AA	gas(ed)	A, P	grip	35
flop	5, P	gate	AA, P, F, V	grope	10, P
flow(ed)(s)	AA	gauge	5	group(s)	AA, P
(n)		gave	AA	grove(s)	31, P
flung	31	gay	A	grow	AA
flush(ed)	23, P	gaze	A	guard	AA
fly	AA	gear(s)	9	guess	AA, P
foam(ed)	21, P	GEIGER	-	GUESSER	-
foe	23, P	GERONIMO	-	guest	A, D
fog(s)(gy)	18	get	AA, P, F, V	guide	AA
fold	A, P, M	giant	A	gulch	3
foot	AA, P, V	gird	6	gulf	33
for	AA, P, V	girl	AA	gull	5, P
force(d)	AA, P	give	AA, P	gun(s)	
fore	11	glad	AA	gust	6, M
fork(ed)	31	glare	26	GYRO	-
form(s)	AA, P	glass	AA		
forth	AA, P	glaze	9	hack	7, P
forty	A	gleam	35	had(n't)	AA, P, V
foul	27, V	glide	24	haft	-
fould	-	gloom	18	hail	40, V
found	AA	glove	43, P	half-ve	AA
four	AA	glow	A	halt	29
fourth	A	go(ne)	AA, D	hand	AA
FO-WER	-	goal	21	hang	AA, M, V
FOX	25	GOBLIN	14	hard	AA
FOXTROT	-	GOLF	26, P	harm	A

EXHIBIT 26 (Continued).

harsh	17	HOTEL	A	keep(s)(t)	AA, P, D
has	AA	hours	AA	KEEPER	23
hatch(ed)	19, P	how(-'d)	AA, P	kill	AA, P, F, M
hate	A, P, F	howl	34, P, V	KILO	-
haul	21	hue	12	kind	AA, P
have(n't)	AA, P	huge	A	kink	1
hawk(s)	22	HUGO	5	knife	A, P
haze,-y	5	huh	3	knob	7
he(-'d) ('ll)	-	hull	8, P	knock	A, D
('s)	AA	hum	20, P, V	knöt	26
head(ing)	AA, V	hump	5, P	know	AA
heap	46, P, M	hunch	5, P	lace	32, M
hear	AA, P, M	hung	A	lack	A, F
heat	AA, P, F, M, V	hunt	A, P	lag	9, P
heave	18, M	HUNTSMAN	6	laid(-n)	AA, V
HECKLERS	-	hurl	20, P	lakes	AA
hedge	32, P	hurt	AA, P, V	lame	29, M, V
heed	21, P, V	HUSH	26, P	lamp(s)	A, D
held	AA	ice(d)	AA, P	lance	16
hell	31	I('d)('ll)	-	land(s)	AA
helm	13	('m)	AA	lane	32, M
HELOT	1	IDENT	-	lap	36, P, D
help(ed)	AA	IDENTIFY	20	lapse(d)	8
hen	49, F, M	ill	AA	large	AA
her(s)	AA	in	AA, P	lash	22, P
here	AA	INDIA	46	last	AA, P, F, V
hex(ed)	-	INTERFERENCE	11	latch(ed)	8, P
hid(e)	A, P, F, V	INTRUDERS	6	launch(ed)	18
high	AA, P	isle	28, P	lay	AA, P, M, V
hight	5	isn't	AA	LAZY	25
hill(s)	AA, P, M, V	it('d)(s)	AA, V	lead	AA
hind	26	jab	2, P, D	leak	8, D
his	AA, P	jam	16, P	leap(ed)	A, D
hiss	16, P	jerk(ed)	18	least	AA, V
hit(s)	A, P, F, M, V, D	jet	9	leave(s)	AA, P
hitch	9, P	jinx	-	led	AA, P, F, M, V
ho	16	joy	4	lee	28, V
hoist	10	join(ed)(s)	AA	left	AA, P
hold(s)(ing)	AA, F, M	joint	36	leg	AA, P
hole(s)	AA, F, V	jolt	5, P	less	AA, P
hōme(s)	AA, V	joy	AA	let(s)	AA, F, V
HOMER	-	judge(d)	AA, P	LEVEL	A
hood	21, P, V	JUDY	9	lie	AA
hook	47, P, F, M	JULIETT	7	LIFEGUARD	-
hop	35, F, M, D	jump	A, F	lift	AA
hope(d)	AA	just	AA, F, M	light(s)	AA, F, V
horn	A, F	jut	6	like(d)	AA, V
HOSTILE	20			LIMA	2
hot	AA, P, F, M, V			limb	38, V

EXHIBIT 26.(Continued).

<u>line(d)(s)</u>	AA,P	meéet(s)(-t)	AA,V	neck	AA,P,D
LINER	4	méilt(ed)(s)	A	NEGATIVE	10
<u>link(ed)</u>	24,F	men	AA,F,M	need(n't)	AA,P,D
lip	AA,P,F,M,D	<u>merge(d)</u>	6,P	nest	A,P,F,M
list	A,V	mesh	6,P	net	A,P,V,D
lit	16,P,V	mess	17,V	new	AA,P
live	AA	mid	11	next	AA,P
load(s)	A,V,D	MIDDLEMAN	2	nice	AA,P
lob(bed)	-	MIDNIGHT	A	night	AA,P,F,V
lobe	2	midst	44	NIGHTCAP	2
LOCAP	-	might	AA,F,V	NIGHTRECCO	-
lock(ed)	A,F,V,D	<u>mike</u>	-	nil	-
lodge	48	mil	1	<u>nine(r)</u>	AA,P,F
loft	8	mild	32	ninth	22,P
lone	22	mile(s)	AA	nip	6,P,D
long	AA,D	mind	AA	no	AA,P
look(ed)	AA,P,F,M,V	MINUS	2	NOCOP	-
loom(ed)	21,V	mirk	-	NODUB	-
loop(ed)(s)	15	miss(ed)	AA,V	noise	A
loose	A,P	mist	29,P	none	AA
<u>lose(-t)</u>	AA,P,V	mix(ed)	A	noon	AA,F,D
loss	AA,P	MIXUP	-	nor	AA
lot	AA,F,M,V,D	mock	31,F	norm	-
loud	A,P,V	mode	23,P	NORMAL	41
<u>low</u>	AA,P,V,D	moist	19	north	AA
luck	46,F	moon	AA,F,D	not	AA,P,F,M,V
lull	11	mop	5,P,F,M	notch(ed)	11,P
lunge	2,P	more	AA,F,V	note(s)	AA,P,V,D
lurch(ed)	3	morse	7	NOVEMBER	A
lurk	15	most	AA,P	now	AA
main	A,F	mound	17	nudge(d)	2,P
make(--de)	AA,P,F	mount	AA	null(ed)	1
MAKER	27	mouth	AA,P	numb(ed)	5
<u>many</u>	AA	move(d)(s)	AA,P	nurse(d)	A
map	A,P,M	mow	6,P	O'CLOCK	A
MAPPO	-	much	AA	OCTOPUS	2
mark(ed)	AA,F,M	muck	5,P	odd	38,P
marsh	16	mud	47,P	of	AA
mask	17	murk	-	off	AA,P
mass	A,P,M	mush	2,P	oh	AA
mat	18,M,V	MUSHROOM	10	oil	AA,M
match	A	must	AA,F,M	OKAY	3
may	AA,P,F,M	my	AA,P	old	AA
MAYDAY	-	name	AA,F,M	on	AA,P
maze	6,P	NANCY	15	once	AA
me	AA,P	near	AA	one	AA
mean	AA	neat	29,P,F,M	or	AA,P
meant	A	'neath	-	ORANGES	A
MEDIUM	23			ORBIT(ING)	10

EXHIBIT 26 (Continued).

OSCAR	2	plan(ned)	AA	quick	A,P
other	AA	plane	A	quiet	A
ought(-to)	AA,P	plant	AA	quit	49
our	AA,P	plate	A	quite	AA
out(er)	23,P,V	PLAYBOY	-	rack(ed)	29,P
over	AA	please(d)	AA,P	raft	7,P
own	AA,P	plight	11	raid	11,P,V
pace(d)	A,M	plod	5,P	rain	AA,F
pack	A,P,F	plop(ed)	-	raise(d)	AA,P
pad	17,P,M	plot	36	ram(med)	16
paint	AA	plow(ed)	35,P	ramp	1,P,D
pair	AA,V	plunk	-	RAMROD	1
pale	A,F,M,V	<u>plus</u>	10,P	ran	AA
PAN	A,P,M,V,D	plush	1,P	rang	25,F,M
PANCAKE	6	PLUTO	3	range(d)	A,P
PAPA	34	pod	3,P	rank	A
par	5	FOGO	-	rap	10,P,D
park(ed)(s)	A,P,F,M	<u>point</u>	AA	RAPCAP	-
PARROT	9	pole	A,V	rare	43
part(s)	AA,P	pond	30,P,D	rate	AA,P,F,M,V
PARTNER	32	pool	34,V,D	raw	46,P,F,M,D
pass	AA,P,M	poor	AA,V	ray	A,P,M
past	AA,P,F	pop(ped)	21,F,M,V	reach(ed)	AA,P
patch(ed)	34,P	POPEYE	-	read(past)	AA
path(s)	AA,P,M	pore	8	READY	AA
pause(d)	A	<u>port</u>	A	real	AA,P
pave(d)	14,M	POSITION	AA	rear	A,P
pay	AA,F,M,V	post	AA	RECCO	-
peak(ei)	28,M,D	POUNCE	6,P	reck(ed)	2
peal	9,M	prang(ed)	-	RECKON	21
PEDRO	4	press(ed)	AA,P	red	AA,F,M,V
peg(ged)	9,P,D	prey	28	reef	6,P
per	A	prime(d)	17,P	reel(ed)	19,F,M
phase(d)	15,P	prior	15	REPORT	AA
pick(ed)	AA,P,F,M	prone	6	RESCUECAP	-
piece(d)	AA	PRONTO	-	RIALTO	-
PIGEONS	34,P	prop(s)	-	rich	AA
pile	A,P,F,V	prowl	7	rid	33,P,F,J,D
pin(ned)	43,F,M,V	puff	28,P,M	ride	AA,P,F
pinched	20	pull(ed)(s)	AA	ridge	31,P
pine	A	pump(ed)	29,P,F	<u>right</u>	AA,F,V
ping		<u>punch(ed)</u>	17	rim	12
pink	A,P,F	punt	P	ring	AA
pip	M	purge(d)	6,P	rip(ped)	19,P,F,M,D
pit	29,P,M,V	PURPLE	37	rise(s)	AA,P
pitch(ed)	43,P	purr(ed)	6	risk(ed)	40,P
place(d)	AA	push(ed)	A	road	AA,V,D
plain	AA	put	AA,P	roar	A,P
		QUEBEC	7		

EXHIBIT 26 (Continued).

<u>roll(ed)</u>	AA,P	<u>send(s) (-t)</u>	AA,F,M	<u>sky(-ies)</u>	AA,P
ROMEO	5	<u>sense</u>	AA,P	SKYROCKET	-
<u>roof</u>	AA	<u>serf</u>	4	<u>slab</u>	7,P
<u>room</u>	AA	<u>set</u>	AA,P,F,V	<u>slack</u>	7
<u>rough</u>	A,P	SEVEN	AA	slam(med)	11
<u>round</u>	AA	<u>shock</u>	7,P	slant(s)	10
<u>route</u>	A	<u>shade</u>	AA,P	slap(s)	13,P
<u>row(s)</u>	A,D	SHADS	1	slash	8,P
<u>ruin(ed)</u>	A	<u>shaft</u>	25,P	<u>sleet</u>	5
<u>run(s)</u>	AA,F,M	<u>shake</u>	A	<u>slice(d)</u>	30,P
<u>rush(-d)</u>	AA,P	<u>shall</u>	AA	<u>slick</u>	3
<u>rut</u>	3,P,V	<u>shape(d)</u>	AA	<u>slide</u>	36,P
<u>sare</u>	AA,M	<u>share</u>	AA,P	<u>slight</u>	A,V
<u>said</u>	AA,V,D	<u>sharp</u>	A	<u>slim</u>	14
<u>sail</u>	AA,F	she('d)('ll)		<u>sling</u>	8
SALVOS	-	('s)	AA	SLINGSHOT	-
<u>same</u>	AA,F,M	<u>shear</u>	12	<u>slip(ped)</u>	A,P
<u>sand</u>	A	SHECAT		<u>slosh(ed)</u>	-
<u>sank</u>	32,D	<u>sheet(s)</u>	A,V,D	<u>slot</u>	3,V
SAPPHIRE	6	<u>shell(ed)</u>	A	<u>slow(ed)</u>	A
<u>sat</u>	AA,P,M,V	<u>shift</u>	35	<u>slug</u>	5,P
SAUNTER	4	<u>ship</u>	AA,P	<u>slung</u>	3
<u>save(d)(s)</u>	AA,M	<u>shook</u>	A,P,M	<u>small</u>	AA
<u>saw</u>	AA,M,D	<u>shoot</u>	A,V	<u>smash(ed)</u>	12,P
<u>say(s)</u>	AA,F,M	<u>shore</u>	AA	<u>small</u>	A
<u>scan(ned)</u>	8,P	<u>short</u>	AA	<u>smoke(r)</u>	AA
<u>scoop</u>	8	<u>shot</u>	AA,P,V	<u>snap(ped)</u>	49
<u>scope</u>	11	<u>should(n't)</u>	AA	<u>snatch(ed)</u>	27
<u>score(d)(s)</u>	A	<u>show(n)</u>	AA,D	<u>sneak</u>	10
<u>scout</u>	37,P	<u>shower(s)</u>	41	SNOOPER	-
<u>scram</u>	-	<u>shroud</u>	9	<u>snow(ed)</u>	AA,P
SCRAMBLE	17	<u>shut(s)</u>	AA,P	<u>snub</u>	2
<u>scrap(ped)</u>	18	<u>sick</u>	AA,P,F,M,V	<u>so</u>	AA,P,D
<u>scrape(d)</u>	18	<u>side</u>	AA,P,F,V	<u>soar</u>	12,P
<u>scratch</u>	30,P	SIERRA	3	<u>sod</u>	10,P,F,V
<u>screen(ed)</u>	39	<u>sight</u>	AA	<u>soft</u>	AA
<u>screw</u>	20	<u>sign</u>	AA,P,V	<u>sole</u>	25,D
<u>scrub(bed)</u>	14,P	<u>silk</u>	A	<u>solve(d)</u>	33,P
<u>sea</u>	AA	<u>since</u>	AA	<u>some</u>	AA
<u>seal(ed)</u>	45,F	SINGLE	AA	<u>soon</u>	AA,F,V
<u>search(ed)</u>	A	<u>sink(s)</u>	A,F	<u>sought</u>	-
<u>seat(s)</u>	AA,F,M,V	<u>sit(s)</u>	AA,P,F,M,V	<u>sound</u>	AA
SECTOR	2	<u>site(s)</u>	21	<u>soup(ed)</u>	36
SECURITE	-	SITREP	-	<u>SOUR</u>	15,P
<u>see</u>	AA	six(th)	AA	<u>source</u>	A
<u>seek</u>	AA,M	<u>size</u>	AA,P	<u>south</u>	AA,P
<u>seem(ed)</u>	AA,M	<u>ship(ped)</u>	17	<u>space(d)</u>	AA
<u>seen</u>	AA,M	<u>skirt</u>	A	<u>span</u>	13,V
<u>seize</u>	A	SKUNK	13	<u>spare</u>	A
<u>self</u>	A				

EXHIBIT 26 (Continued).

<u>speck</u>	13	<u>strap(s)</u>	15,P	<u>TALLY-HO</u>	-
<u>speech</u>	AA	<u>stray(ed)</u>	18	<u>TANGO</u>	-
<u>speed(s)(-d)</u>	A	<u>(s)</u>		<u>tank(ed)</u>	19
<u>spent</u>	A	<u>streak(ed)</u>	15	<u>tap(ped)</u>	32,P,M,V
<u>spill</u>	12	<u>steam(ed)</u>	AA	<u>tape</u>	8,V
<u>spin</u>	24,V	<u>street</u>	AA	<u>TARCAP</u>	-
<u>splash(ed)</u>	20,P	<u>strength</u>	AA	<u>TARGET</u>	9
<u>split(s)</u>		<u>stress(ed)</u>	13,P	<u>task</u>	A
<u>(ting)</u>	26	<u>stretch(ed)</u>	A	<u>TASP</u>	-
<u>spoke</u>	AA	<u>strict</u>	12	<u>tear</u>	AA,M
<u>SPOOFER</u>	-	<u>strike</u>	AA	<u>tease</u>	14,M
<u>spool(ed)</u>	7	<u>string</u>	A	<u>tell</u>	AA,P,F,V
<u>spot(ter)</u>		<u>strip</u>	A	<u>ten</u>	AA,P,F,M,V
<u>spcut</u>	6	<u>stripe(d)</u>	14	<u>tend</u>	A,F
<u>spread(s)</u>	AA	<u>strive</u>	19	<u>tenth</u>	23
<u>spring</u>	AA	<u>strong</u>	AA	<u>test(s)</u>	A,P,F,M,D
<u>sprint</u>	1	<u>stuck</u>	34	<u>than</u>	AA,P,D
<u>spun</u>	12,V	<u>strung</u>	2	<u>tnank(s)</u>	AA,P,D
<u>spur</u>	23	<u>strut</u>	8	<u>that</u>	AA,P
<u>squall(ε)</u>	4	<u>stuck</u>	34	<u>thaw(ed)</u>	8,P,M,D
<u>SQUAWK(ING)</u>	4	<u>stud</u>	8	<u>the</u>	AA
<u>square</u>	A,	<u>stuff</u>	A,P	<u>their(s)</u>	AA
<u>squeal</u>	5	<u>sub</u>	1,M	<u>them</u>	AA,P
<u>squelch(ed)</u>	-	<u>SUBCAP</u>	-	<u>then</u>	AA,P,M,D
<u>squib</u>	-	<u>suck</u>	AA,P	<u>there('s)</u>	AA,P
<u>stack</u>	11,V	<u>sun</u>	AA,F,M	<u>these</u>	AA
<u>stalk(ed)</u>	27,V	<u>sunk</u>	17	<u>they('d)('11)</u>	
<u>stall</u>	19,V	<u>sure</u>	AA	<u>('re)('ve)</u>	AA
<u>stand(s)</u>	AA	<u>surf</u>	4	<u>thick</u>	A,P,D
<u>star(s)</u>	AA,V	<u>surge(d)</u>	12	<u>thickened</u>	5
<u>STARBOARD</u>	3	<u>swamp</u>	29	<u>thin</u>	AA,P,D
<u>start(s)</u>	AA,P	<u>swap</u>	2	<u>thing</u>	AA,D
<u>state</u>	AA	<u>sway(ed)</u>	36	<u>think</u>	AA
<u>stay(s)(ed)</u>	AA	<u>sweep</u>	44	<u>third</u>	AA
<u>STEADY</u>	A	<u>sweet</u>	AA	<u>this</u>	AA,P
<u>steep</u>	40	<u>swell</u>	A	<u>those</u>	AA,P,D
<u>steer</u>	33,V	<u>swift</u>	43	<u>though</u>	AA,P,D
<u>stem</u>	39	<u>swing</u>	A	<u>thought</u>	AA
<u>stick(s)</u>	AA,V	<u>swirl</u>	7	<u>thread</u>	A,P
<u>stiff</u>	44,P	<u>switch(ed)</u>	15	<u>threat</u>	17
<u>still(ed)</u>	AA,V	<u>swoop(ed)</u>		<u>three</u>	AA,P
<u>stink(s)</u>	4	<u>(s)</u>	7	<u>throw</u>	A
<u>stood</u>	AA			<u>thrust</u>	40
<u>stop(ped)</u>	AA	<u>tab(s)(bed)</u>	1,P,M	<u>thud</u>	4,P
<u>store</u>	AA,V	<u>tad</u>	-	<u>THU-REE</u>	-
<u>storm</u>	AA	<u>tag</u>	7,P	<u>tide(s)</u>	46,F
<u>straight(en)</u>	AA	<u>tail</u>	A,F	<u>tie(d)</u>	AA,V
<u>strain(ed)</u>	A	<u>take</u>	AA,P,F	<u>tight</u>	35,
<u>STRANGER</u>	A	<u>talk(ed)</u>	AA	<u>till</u>	AA,F,M,V
<u>STRANGLE</u>	3	<u>tall</u>	AA,V		

EXHIBIT 26 (Continued).

<u>tilt</u>	12,P	<u>two</u>	AA	<u>WEATHER</u>	AA
<u>time</u>	AA,P	<u>type</u>	AA,V	<u>weave</u>	22,P
<u>tip(s)</u>	A, P,F,M,V			<u>week</u>	AA
<u>tire</u>	AA,P,F	<u>UNABLE</u>	37	<u>weigh</u>	A
<u>t'll</u>	-	<u>UNIFORI</u>	A	<u>weight</u>	AA
<u>to</u>	AA,V	<u>UNKNOWN</u>	A	<u>well</u>	AA,F
<u>told</u>	AA,F,M	<u>up</u>	AA,P	<u>went</u>	AA,F,M
<u>ton(s)</u>	49,P	<u>us</u>	AA,P	<u>were</u>	AA
<u>tone</u>	A,V	<u>use(d)</u>	AA,P	<u>west</u>	AA,F,M
<u>too</u>	AA			<u>wet</u>	A
<u>took</u>	AA,F,M	<u>vague</u>	20,P	<u>what</u>	AA
<u>TOOL</u>	40,V,D	<u>van</u>	29	<u>wheel(s)</u>	A,P
<u>top(ped)(s)</u>	AA,F,M,V	<u>vane</u>	3	<u>when</u>	AA
<u>torque</u>	-	<u>vary</u>	A	<u>where</u>	AA
<u>toss(ed)</u>	46	<u>vast</u>	A,P,D	<u>which</u>	AA
<u>touch(ed)</u>	AA,P	<u>VECTOR</u>	-	<u>while</u>	AA
<u>tough</u>	18	<u>veer</u>	3	<u>whine(d)</u>	11
<u>tow(ed)</u>	9	<u>vent(s)</u>	7	<u>whip</u>	41
<u>toward</u>	AA	<u>verge</u>	9	<u>whirl</u>	31
<u>tower</u>	A	<u>VERY</u>	AA	<u>WHISKEY</u>	9
<u>town</u>	AA,V	<u>via</u>	8	<u>white</u>	AA,P
<u>trace</u>	A	<u>VICTOR</u>	11	<u>who</u>	AA,P
<u>track(ed)</u>	A	<u>view(ed)</u>	AA	<u>whole</u>	AA
<u>TRACTORS</u>	12	<u>VISIBILITY</u>	1	<u>whose</u>	AA
<u>trait</u>	7	<u>voice</u>	AA	<u>why</u>	AA,P
<u>trade</u>	AA,P	<u>void</u>	12,P	<u>wide</u>	AA,P,F
<u>TRAILOR</u>	-	<u>volt(s)</u>	2	<u>width</u>	28
<u>train</u>	AA			<u>wield</u>	6,P,D
<u>TRANSPOUNDER</u>	-	<u>way</u>	12,P	<u>wild</u>	AA,P
<u>trap(ped)</u>	42	<u>wait</u>	AA,P	<u>will(-on't)</u>	A,F,M
<u>trash</u>	3,P	<u>wake</u>	A, P,F	<u>win</u>	A,F,M
<u>TRIDENT</u>	1	<u>wall(ed)</u>	AA,D	<u>wind</u>	A,F
<u>tried</u>	AA	<u>wane(d)</u>	7	<u>wind</u>	AA
<u>trim(med)</u>	42	<u>want</u>	AA	<u>wing</u>	AA
<u>trip(ped)</u>	AA,P	<u>warm(ed)</u>	AA	<u>wipe</u>	45,P
<u>troop</u>	A,P	<u>warn</u>	A	<u>wire</u>	A,P,F
<u>TROT</u>	21	<u>warp</u>	12	<u>wish(ed)</u>	AA,P
<u>true</u>	AA,P	<u>was</u>	AA	<u>with</u>	AA,P
<u>trunk</u>	48	<u>wash(ed)</u>	AA,P	<u>word</u>	AA
<u>try</u>	AA	<u>waste</u>	AA,P	<u>work(ed)</u>	AA
<u>tuck</u>	22,P,F	<u>watch</u>	AA,P	<u>worn</u>	A,F
<u>tug</u>	16,P	<u>watt(s)</u>	2	<u>worse</u>	A
<u>tune(d)</u>	32,D	<u>wave(s)</u>	AA,P	<u>worst</u>	A
<u>turn(ed)(s)</u>	AA,P,V	<u>way</u>	AA,F,M	<u>worth</u>	AA
<u>twelve</u>	AA	<u>we('d)('ll)</u>		<u>would(n't)</u>	AA
<u>twice</u>	A	<u>('re)(ren't)</u>		<u>wreck</u>	41,P
<u>twin</u>	25	<u>('ve)</u>	AA	<u>write</u>	AA
<u>twirl</u>	3	<u>weak</u>	A,P	<u>wrong</u>	AA,D
<u>twist</u>	42	<u>wear</u>	AA	<u>WUN</u>	-

EXHIBIT 26 (Continued).

X-RAY	2
yank	2
YANKEE	12
yaw(ed)	-
YELP	5
yes	AA
yet	AA,P,F
yield	A,P,D
you('d)('ll)	
('re)('ve)	AA,P,D
your(s)	AA
 ZERO	 11
zone	26,P
zoom(ed)	-
ZULU	1

EXHIBIT 26 (Continued).

B. PHRASES

air borne	creep by	form right	IN THE DARK
air brake	crew rest	form up	I STAY
air line		four miles	
air plane	DAVEY JONES	FREE LANCE	join up
air speed	day break	freeze line	joy stick
air start	DECK CLEAR	front side	
aisle seat	DECK FOUL	fuel dump	keep clear
alls calm	dense fog	fuel feed	keep pace
ANY FACE	dim lights	fuel flow	
arm guns	dive time	fuel gauge	lap belt
	dog leg	fuel pod	lead ship
bank left	dome light	fuel pump	left flank
bank right	down hill	full flaps	left side
base leg	down wind	full speed	left turn
BENCH MARK	drag chute	fuze box	light haze
BAY RUM	draw fire		light mist
big blow	drink fuel	G-force	light rain
BINGO FIELD	drop down	gas gauge	light snow
BINGO STATE	drop tanks	gear down	link up
blade pitch	dry tank(s)	gear up	live fuze
bleed air	dump fuel	glide path	locked down
block time	dump stores	good by	low boost
boards out		ground fire	low pitch
bomb bay	EASE TURN	gun fire	low run
bomb run	east bound	<u>guns free</u>	low side
brake out	east side	<u>guns tight</u>	low tide
break left	EMERGENCY SPACE	half flaps	
break off		hand crank	MACK NO
break right	exit time	hatch closed	MACK YES
break up	face mask	head wind(s)	main gear
bright light	face plate	<u>heads up</u>	main switch
brisk wind	fan jet	high boost	marsh land
build up	far side	high gain	mid course
burned out	fast cruise	high pitch	mild chop
buss box	FEET DRY	high side	
	FEET WET	high tide	new course
call back	fill tanks	high wind	next turn
call sign	class	hold course	<u>no joy</u>
calm sea	's	hold fire	north bound
calm wind	flame out	hold line	north east
CEASE REPORTING	flaps down	home plate	north west
change speed	flaps up	home stretch	nose gear
charge guns	flat tire	hook down	
chase plane	flight deck	JOTEL FIRE	off course
clear air	flight path	hot mike	on course
cloud deck	flight plan		ON THE CLOCK
cloud layer	flood light	ice berg	on top
coast line	<u>fly at</u>	iced up	ON STATION
code book	FLYING AT	I GO	ON TARGET
code three	form left	in range	

EXHIBIT 26 (Continued).

pins in	test flight
pins out	thank you
port side	thick clouds
PREP CHARLIE	three lights
prop jet	TIED ON
prop wash	tight turn(s)
purge tanks	time hack
	tip tank(s)
right flank	touch down
right side	tree top(s)
right turn	trim pad
run up	turn left
	turn right
safe guns	
SAINT BERNARD	warm up
SCENE COMMANDER	WARNING RED
SEE YOU	WARNING WHITE
set course	WARNING YELLOW
shore line	WAVE OFF
shut down	WEAPONS FREE
side slip	WEAPONS TIGHT
sign off	west bound
sink rate	WHAT LUCK
skip bomb	WHAT STATE
SKIP IT	wheels down
slow count	wheels up
slow cruise	wheels well
slow down	WHICH TRANSPONDER
slow flight	wide turn
slow roll	wing man
snap roll	wing tank(s)
south bound	
south east	YELLOW JACKET
south west	you're hot
speed brake	
spin out	
split-S	
spool down	
squall line	
STATE CHICKEN	
STATE LAMB	
STATE TIGER	
STATE WEAPONS	
steep turn	
steer course	
storm line	
stow pins	
tail hook	
tail wheel	
take care	

EXHIBIT 27: ARMY (TACTICAL FIELD) TEST MESSAGES.

QUESTION TYPE

- Q 1. What is the condition of the team?
- Q 2. What is size of enemy force?
- Q 3. Are elements in position?
- Q 4. What is fire mission?
- Q 5. How copy?
- Q 6. What is sit-rep?
- Q 7. Request log-stat.
- Q 8. Have you reached the objective?
- Q 9. What is your location?
- Q 10. Do you need air support?
- Q 11. What is your position?
- Q 12. Are you ready to move into position?
- Q 13. Is your area secured?
- Q 14. Do you need rations?
- Q 15. Are you in contact with the other team?

ANSWER/INSTRUCTION TYPE

- A 1. We need a resupply of ammunition.
- A 2. Move to LIMA ZULU vicinity 679703.
- A 3. You will be extracted at 1600 hours tomorrow.

EXHIBIT 27 (Continued).

- A 4. Am in contact with the platoon sized element.
- A 5. We drew heavy ground fire on the alternate LIMA ZULU.
- A 6. Abort the mission.
- A 7. We have reached the objective - in process of surrounding it.
- A 8. First insert ship shot out.
- A 9. My position from reference point is right one, down four.
- A 10. Need dust off. From check point one down two, left three. Will throw smoke. Have him come up on Battalion Command.
- A 11. I see your smoke. You are approximately one thousand meters from the LIMA ZULU.
- A 12. Am receiving heavy fire from the ridge line to the North.
- A 13. Put the napalm in the bottom of the valley.
- A 14. Ready with smoke - the first stick on final now.
- A 15. Fire for effect.
- A 16. Proceed immediately to point ZULU for extraction of element. Upon completion of extraction, initiate plan CHARLIE.
- A 17. Sit-rep negative.
- A 18. Attack enemy at 532714 at 0600 hours.
- A 19. Need interpreter and MI team at 546823 at 2100 hours.
- A 20. Move your unit to 633721 and defend. Prepare to attack.
- A 21. Be prepared for a CHARLIE ALPHA. Will give details later.
- A 22. Estimated ECHO TANGO ALPHA of resupply is 2200 hours.
- A 23. We are moving into NOVEMBER DELTA PAPA.
- A 24. Switch over to alternate frequency.
- A 25. From target ALPHA FOXTROT 2011, direction 1540, right 400, add 200, up 30. Infantry platoon in trenches. VT in effect. Adjust fire.
- A 26. Grid 627938, ranging rounds, adjust fire.

EXHIBIT 27 (Continued).

- A 27. From registration point 1, direction 1200, right 400, adj 150. Enemy convoy, WHISKEY PAPA and HOTEL ECCO. Fire for effect.
- A 28. Search and destroy area 726650.
- A 29. Have discovered an enemy bunker system.
- A 30. Registration point 2, direction 2600, registration adjust fire.
- A 31. Hold enemy at 630725.
- A 32. Command post located at 722804.
- A 33. Friendly casualties KIA 9, WIA 13, MIA 2.
- A 34. Need airborne psywar team at _____.
- A 35. This frequency compromised. Change to alternate.
- A 36. We need immediate air support. Our situation is critical.
- A 37. We need 3 cases of Charlie 4 to destroy tunnel system.
- A 38. Need ammunition.
- A 39. Aircraft in vicinity.
- A 40. Observe radio silence.
- A 41. Call me on land live at 2000 hours.
- A 42. Have located large cadre consisting of food and ammunition.
- A 43. Have started to reach village.
- A 44. Trains located at 543202.
- A 45. Have consolidated as of 1500 hours.
- A 46. Grid 233629, Enemy patrol, fire for effect at my command.
- A 47. Maintain 75% until 0930 hours.
- A 48. Report to my location by 2100 hours.
- A 49. Send chaplain.

EXHIBIT 28: 150 FLIGHT DECK PHRASES.

These 150 phrases were fabricated by Roy Klumpp to obtain speech material which would be similar to that which might be delivered over the Flight Deck Radio Link System.

1. USE THE OTHER CREW
2. THE PILOT SAYS IT'S DOWN
3. KNOCK OFF THE CHATTER
4. THE FORE IS OUT NOW
5. WHERE IS THE PLANE CAPTAIN?
6. I CAN'T HEAR YOU
7. TRY TO FIX IT FORWARD
8. THE DECK IS SLIPPERY
9. HE LOST HIS GOGGLES
10. SEND FOR THE MEDIC
11. TAKE 103 AFT
12. WE NEED AN AIR STARTER
13. WHAT IS THE WIND?
14. BRING 6 BRIDLES
15. DROP IT DOWN #1
16. WAVE ONE HAND
17. ARE YOU READY?
18. HE BROKE HIS ARM
19. SEND FOR A PUSHER CREW
20. THE WIND IS 33 KNOTS
21. HAUL IT BACK HERE
22. FIRE IN THE PORT CATWALK
23. THE COD IS READY
24. HYDRAULIC LEAK ON THE F4J
25. MAKE IT TWO FEET LONG
26. RAISE YOUR RIGHT FOOT
27. A MIRROR LIGHT IS OUT
28. FUEL LEAK ON THE A7
29. WHERE IS THE FLIGHT DECK CHIEF?
30. MY RECEIVER IS DOWN
31. OUR JOB IS DONE
32. GIVE ME A SLOW COUNT
33. READY TO LAUNCH NOW
34. TIE DOWN 204
35. NUMBER TWO IS FLYING
36. SEND US A MAN
37. PRI FLY SAYS NO
38. BRING UP # 1 ELEVATOR
39. BRING A HAMMER
40. BOMB CRATER AT FRAME 62
41. SECURE THAT FIRE HOSE
42. WHAT PLANE IS NEXT?
43. CALL ME LATER
44. GET BEHIND THE ISLAND
45. PULL OUT 005
46. FLAT TIRE ON 211
47. PULL OUT THE PIN
48. WHAT WAS THE MESSAGE?
49. CRASH ON THE FAN-TAIL
50. WHAT CHANGE SHOULD WE MAKE?
51. NUMBER ONE IS NOT WORKING
52. WHERE IS THE BEST PLACE?
53. SEND 10 MEN FORWARD
54. FIRE THE PORT CAT
55. CUT THE LINE
56. CALL THE ARMAMENT PARTY
57. WATCH OUT FOR JET BLAST
58. TWO AD'S AT FRAME 51
59. WE NEED THREE BRIDLES
60. THE TAIL HOOK WON'T RETRACT
61. SPOT IT NEXT TO 107
62. TRY OUT THE FORWARD ONE
63. CHECK FOR FUEL LEAKS
64. WE NEED A HOSE
65. LOAD ROCKETS ON 120
66. JONES SAYS 212 IS DOWN
67. HOLD THE NEXT PLANE
68. WATCH OUT FOR THAT WIRE
69. FLY 2 IS HURT
70. NUMBER 110 IS DOWN
71. USE NUMBER 3 ELEVATOR
72. HOW MANY DID YOU SAY?
73. HURRY UP FORWARD
74. SEND US TWO TRACTORS
75. LAUNCH AT 0910
76. WHERE IS MR. JOHNSON?
77. RAISE YOUR RIGHT HAND
78. ITS AT THE NUMBER 3 SPOT
79. HOW MANY DID YOU WANT?
80. CARRY IT UP HERE
81. CASUALTY AT THE MIRROR
82. BRING US SOME GLOVES
83. SEND MR. AVERY DOWN
84. FIRE DRILL AT 0700
85. WHAT COLOR IS IT?
86. OUR TRACTOR IS DOWN
87. CHANGE THE REAR TIRE
88. COVER IT WITH SAND
89. FIRE NUMBER 2 FIRST
90. GAS UP THE AD'S
91. HOW MANY ARE LEFT?
92. START UP 607

EXHIBIT 28 (Continued).

- | | |
|--|---|
| 93. THE TIME IS 1000 | 123. FOUR MEN ARE NEEDED |
| 94. WHERE'S 102 AT NOW? | 124. CHECK FOR STICKING CONTROLS |
| 95. BRING 3 FLASHLIGHTS | 125. HOW MUCH FUEL IS LEFT? |
| 96. OPEN UP THE BOX | 126. BOTH WINGS ARE GONE |
| 97. NUMBER 27 IS FUELED | 127. SEND FOR MORE BATTERIES |
| 98. LAUNCH THEM NOW | 128. THE PORT WING IS DAMAGED |
| 99. START ENGINES IN FIVE MINUTES | 129. 713 IS DUE NEXT |
| 100. 101 MADE A TOUCHDOWN | 130. WHY IS IT DOWN? |
| 101. FLY-1 IS GONE | 131. HOW MANY DO YOU WANT? |
| 102. 90 POUNDS OF AIR PRESSURE | 132. WHAT WAS THE PRESSURE? |
| 103. BOMB HOIST NUMBER 2 IS OUT | 133. THE WIND IS 41 KNOTS |
| 104. PORT CAT IS NOW WORKING | 134. CHANGE THE TIRE NOW |
| 105. HOW MANY HELMETS? | 135. SEVEN JACKETS, TWO HELMETS |
| 106. HOLD HIM FOR 6 SECONDS | 136. DROP THAT WIRE |
| 107. GET THE FIRE HOSE OUT | 137. BOMB LOADING IN 10 MINUTES |
| 108. TURN ON YOUR LIGHT | 138. FRAYED ARRESTING GEAR WIRE |
| 109. PREPARE FOR BOMB LOADING | 139. THE TAIL FIN IS DAMAGED |
| 110. FIND OUT WHAT THE FUEL STATUS
IS | 140. THE BULL HORN ISN'T WORKING |
| 111. HOLD 105 FOR 2 MINUTES | 141. WHERE IS THE ARMAMENT CREW? |
| 112. FUEL LEAK ON 111 | 142. GIVE ME A WAND |
| 113. PREPARE FOR LAUNCH. | 143. GET THAT PLANE MOVED |
| 114. FIRE DAMAGE PARTY AFT | 144. NUMBER 3 ARRESTING WIRE IS
BROKEN |
| 115. ERECT THE CRASH BARRIER | 145. IT'S AT FRAME 103 |
| 116. TRACTOR 5 IS BELOW DECK | 146. BRING FOUR CHOCKS ALONG |
| 117. SEND ME A RUNNER | 147. G. Q. IN 10 MINUTES |
| 118. SET FOR 40,000 POUNDS | 148. CHECK THE BLAST DEFLECTOR |
| 119. TURN OFF THE LIGHTS | 149. PULL OUT THE CHOCKS |
| 120. FIND OUT WHAT TIME WE LAUNCH | 150. WHAT IS THE WIND? |
| 121. HE BROKE A LEG | |
| 122. BOMB HOLE IN NUMBER 2 ELEVATOR | |

EXHIBIT 29: FLIGHT DECK WORDS.

- 1) The Flight Deck Words were taken from the Flight Deck Phrases listed in the preceding section.
- 2) No proper names or station identification names were used.
- 3) No word appears more than once.
- 4) Each order is a different randomization of the same 100 Flight Deck Words.
- 5) There is a total of 10 orders.

ORDER 1

1. spot	26. frame	51. elevator	76. degrees
2. launch	27. you	52. have	77. send
3. tractor	28. wing	53. starboard	78. off
4. take	29. flight	54. clear	79. island
5. bay	30. next	55. tell	80. forward
6. time	31. fuel	56. feet	81. facing
7. ready	32. number	57. mirror	82. airborne
8. room	33. position	58. pulled	83. standby
9. call	34. port	59. spotted	84. by
10. fly	35. control	60. repeat	85. back
11. pilot	36. same	61. topside	86. helicopter
12. secured	37. up	62. hop	87. minute
13. catapult	38. gear	63. fire	88. line
14. behind	39. hydraulic	64. phrase	89. sitting
15. right	40. radio	65. tail	90. side
16. nose	41. rudder	66. down	91. where
17. when	42. cat	67. knots	92. lit
18. low	43. leak	68. center	93. place
19. alongside	44. what	69. pusher	94. wind
20. taxi	45. outboard	70. inform	95. between
21. check	46. aircraft	71. cable	96. moving
22. deck	47. go	72. angel	97. belay
23. aft	48. manned	73. blue	98. we
24. gave	49. demon	74. drop	99. now
25. never	50. standing	75. crew	100. is

EXHIBIT 30: TYPICAL MESSAGES IN THE SHIPBOARD AVIATION MAINTENANCE/SUPPLY RESPONSE LOOP, FROM NAVSHIPS (1972).

- Link 4 "Stop work on tail 104 and go to work on tail 108 located at ____."
P/N____ not in pool or need non-pool P/N ____." P/N = Part Number
(Initial removal action, bad part from Supply or after QA.) QA = Quality Assurance
- Link 5 "Part required with priority____, P/N____."
"Exchangeable part will be ready for pick-up at ____."
(bulky items)
"P/N____ obtained from pool."
"P/N____ is available at [location]."
- Link 6 "P/N____ (required/obtained from pool) with PRI____ and Requisition____." PRI = priority
"Part not available. Status is (AIMD, NIS). Due in on____." NIS = Not in Stock
"Reminder to turn in defective items."
"FIN for Requisitions____." (Items which require lock-up.) FIN = Federal Index Number
"AWP part has arrived."
- Link 7 "Part is/is not available."
"AWP has arrived."
"Part Requisition with PRI____ and P/N____."
"Part available" "Part not available"
or
at ____." and status.
"AWP material is available."
- Link 8 "AWP material is available at ____[location]."
"Material available/not available; delivery instructions and part status."
"Requisition P/N____, Requisition Number____, JCN____." (SRA and bits and pieces not in MSP.)

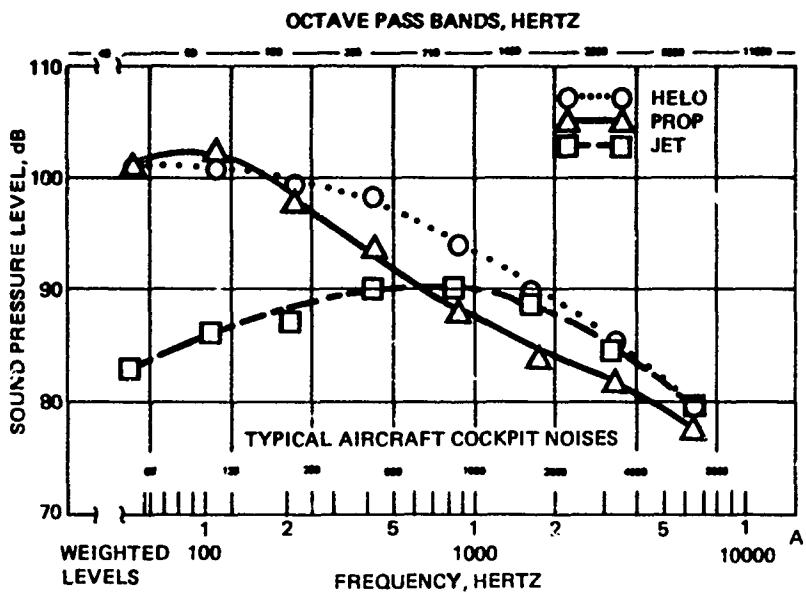
TYPICAL NAVAL NOISES

Unless an equipment is to be tested in its actual environment, as specified in the U. S. Army report (1971), simulated or recorded noises must be added to the test environment. Except for tests in the actual environments using operational personnel, the most valid tests are with talker(s) and listener(s) communicating naturally (no aids to constant voice level, etc.) using the test equipment(s) in a surrounding simulated ambient noise environment. Although records should be kept of talker and listener levels, the communicators should be allowed to choose their own levels. Exceptions to this occur when the talker or the listener level is a parameter under test. Expediency often dictates, however, that a tape recorder be used to record the talker and, at a later time, to play back to groups of listeners.

Feedback to the talkers, unless it is an experimental parameter, should be as it is in the system as actually used. This is highly important, as is the freedom given to the talker of adapting his own vocal effort level. Talkers adapt their levels (1) to the ambient noise levels they are in, (2) to the levels of sidetone (feedback) they receive in their own ears of their own voices, (3) to the contextual situations they are in (one or many listeners, routine or emergency communication scenario, etc.), and (4) to their emotional states (bored, fatigued, excited, angry, scared, fearful, etc.). To the extent possible, these factors must be accounted for.

AIRCRAFT NOISES (COCKPIT)

Figure 3 shows "averaged" noise spectra of three types of aircraft, from Sutherland and Gasaway (1971) based on Gasaway (1969, 1970). In all cases individual cockpit noises of the noisiest aircraft were between 10 and 15dB higher; see Gasaway (1969, 1970) for details and spectra on individual aircraft types. For typical worst-case conditions, these spectra should be reproduced at levels of about 110dB(A) at the position of the head of the talker and/or listener.



TYPICAL JET, HELO, AND PROP AIRCRAFT COCKPIT NOISES, AND HIGHEST LEVEL JET, NOISE, AND JET NOISE LEVEL AT EAR UNDER APH-6A AVIATOR HELMET

*FROM ENCL.(1) NAVMISCEN LTR SER 4216 OF 27 DEC '71 "OXYGEN BREATHING MASK SIERRA MODEL 756 EVALUATION" BY T. V. BLATTEL AND W. J. ENGBRECHT

+FROM SUTHERLAND & GASAWAY (1971)

Figure 3. Typical aircraft cockpit noises.

AIRCRAFT NOISES (EXTERNAL)

Figures 4 and 5 show the spectra of an F4 (Phantom) aircraft running at military power and in afterburner at measured distances of 12.5, 25, 50, 100, and 200 feet at an angle of 60 degrees off the nose. For levels at other angles around the aircraft and for spectra of other jet aircraft see Webster (1971) or the original data sources, Seltz (1961a, 1961b) and Abell (1963a, 1963b).

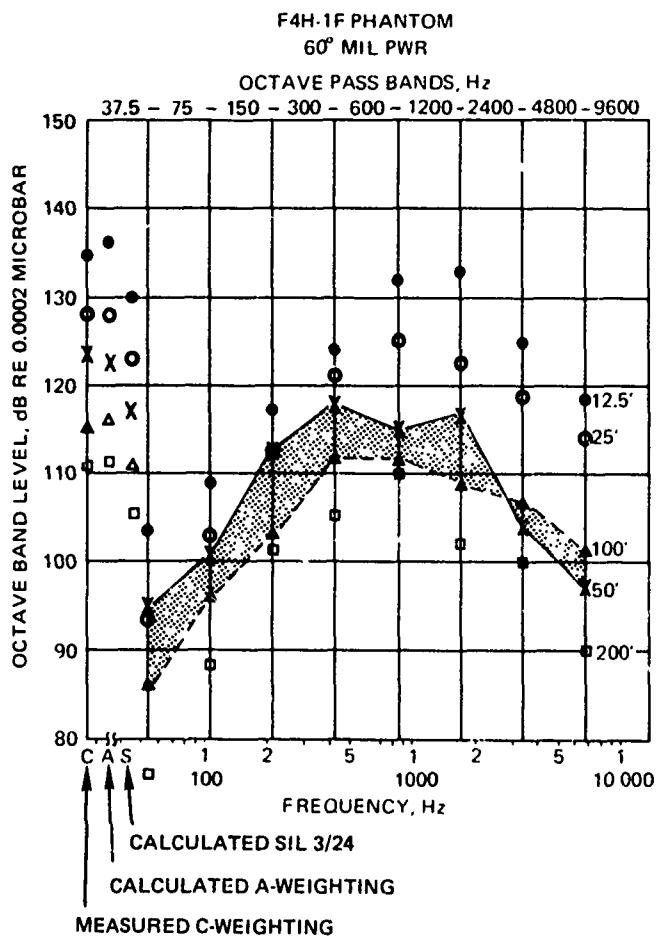


Figure 4. Octave-band noise levels of F4 aircraft running at military power.

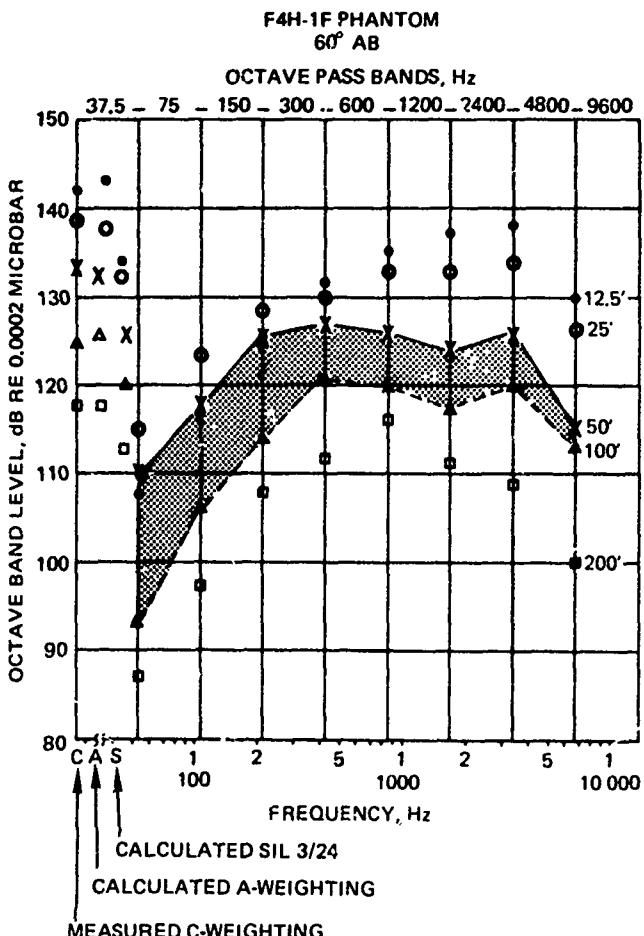


Figure 5. Octave-band noise levels of F4 aircraft running in afterburner.

SHIP NOISES

Except for aircraft noises on ships with jet, propeller, or rotary wing aircraft, the primary ship noises are in the engine room, from ventilating blowers and ducts, from other people talking or listening to music, or from general ship rumble. Spectra of these noises are shown in figures 6-9 at levels that have been adjusted to be equally speech interfering (see Klumpp and Webster (1963)) but not necessarily typical of ship levels. Engine room noises are typically between 95 and 105dB(A); blowers and rumble from 55 to 70dB(A), depending on distance from source, ship speed, etc.; and voice babble from 55 to 80dB(A) depending on the ambient noise in the space in the absence of people.

To test equipment in these noises, use the worst-case or the highest levels just cited.

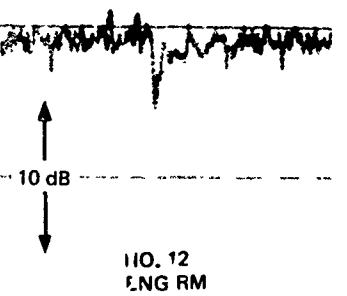
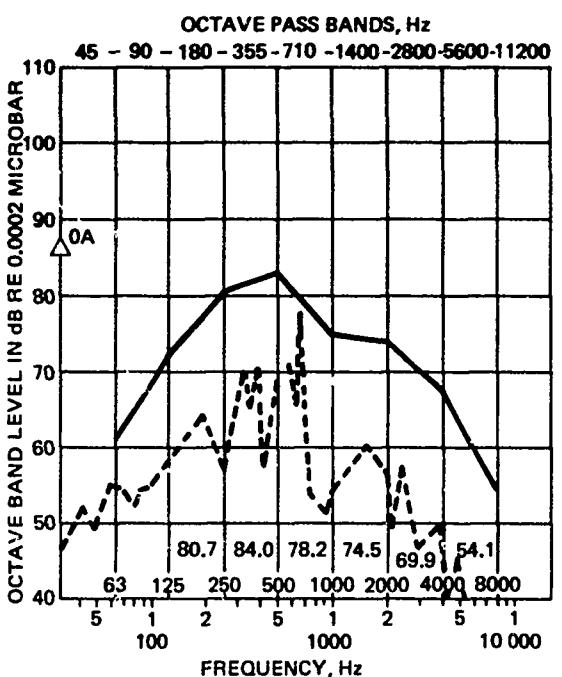


Figure 6. Octave-band and 20-Hz-band levels of engine room noise.

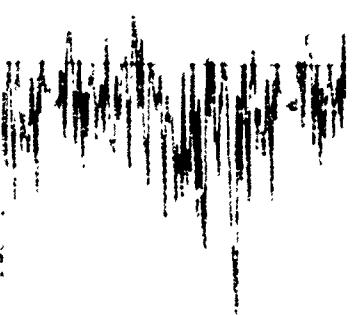
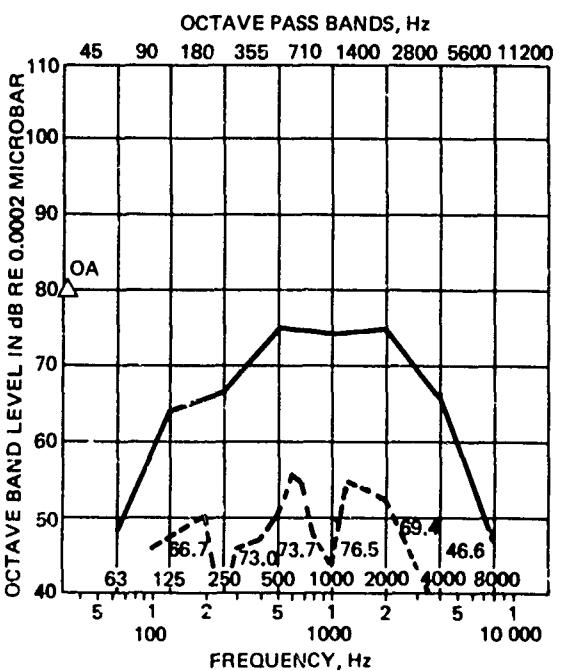


Figure 7 Octave-band and 20-Hz-band levels of voice babble.

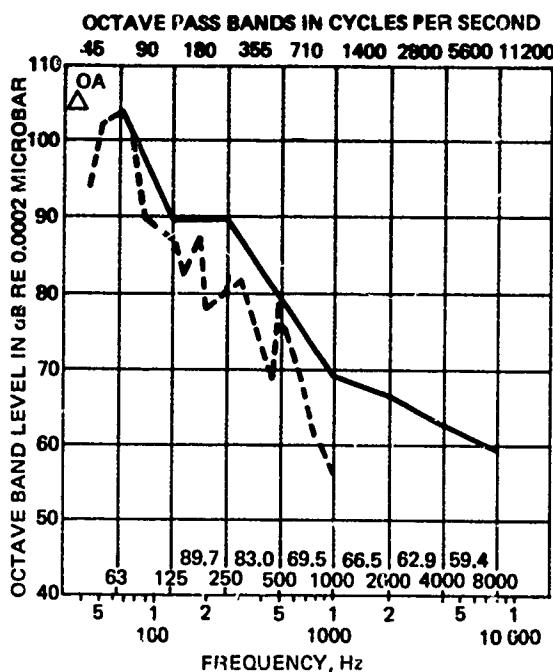


Figure 8. Octave-band and 20-Hz-band levels of ship's rumble.

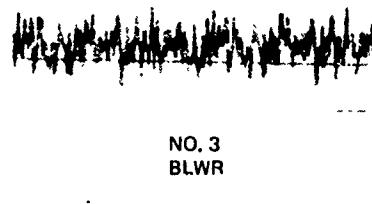
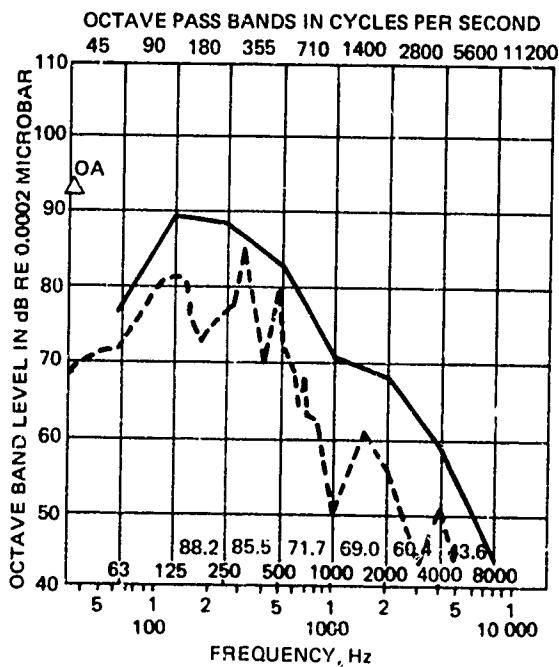
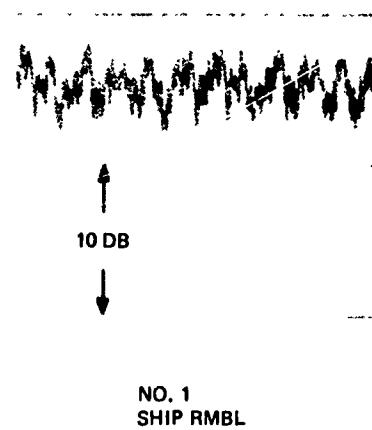


Figure 9. Octave-band and 20-Hz-band levels of blower noise.

COMPARATIVE SCORES AMONG SPEECH MATERIALS

It is often (usually) the case that one speech test is the most appropriate (most efficient, least time consuming, requiring least training of talker/listeners, etc.) but the least amenable to interpreting the results to design engineers, systems managers, or sponsors. For this reason many tests have been run primarily to relate the scores on one type of test to those on others. A few of the results from some of these comparisons are cited here for quick and easy reference.

WORD VOCABULARY SIZE VS SENTENCES AND NONSENSE SYLLABLES

Figure 1 from Kryter et al (1963), adapted from French and Steinberg (1947), shows why using PB words is a dangerous test procedure. For the same physical conditions of speech-to-noise ratio, expressed as Articulation Index (AI), PB word scores may vary from 23% to 85%, depending on vocabulary size. Since vocabulary size, amount of training, etc., are not easy to specify and usually are not specified in detail, the use of PB words should be limited to such things as on-the-spot comparisons between two competing equipments.

There are at least two points of interest: (1) 1000 PB words are nearly as difficult, or discriminating, as nonsense syllables and even though difficult to use are still preferable to nonsense syllables with regard to training time, etc. (2) 32 PB words are easier, even less discriminating than sentences, and to a first approximation it would probably be safe to generalize that scores on one or two PB lists (50 to 100 words) are equivalent to sentence, or everyday connected discourse, scores.

NAVY VS CIVILIAN SPEECH

Montague (1960) found that Pseudo Navy Sentences gave generally equivalent scores, as did Navy Communication Words and Phonetically Balanced Words. Sentence scores were generally 10 to 20 percentage points higher than word scores. He also compared the Fairbanks Rhyme Test (FRT) word scores with the other scores and found FRT scores to be generally equal to sentence scores.

RHYME TEST SCORES VS PB SCORES

Kryter and Whitman (1965), using data from Miller, Heise, and Lichten (1951) and Nickerson et al (1960), conclude that scores on Rhyme Tests (Fairbanks (1958) and House et al) are generally equivalent to scores on 256 PB words. Webster and Allen (1972) show that Rhyme Test scores are generally equivalent to scores on Brevity Code words (including digits and the ICAO phonetic spelling words). Combining the data of all these studies, with the addition of a few approximations, gives the relationships shown in figure 2.

The relationships shown above allow generalizations from test words to actual operational words or phrases so that efficient tests can be administered and generalized interpretation can be made.

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